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DEVELOPMENT OF ANALYSIS CODE FOR THERMAL HYDRO-DYNAMICS OF MARINE REACTOR UNDER MULTI-DIMENSIONAL SHIP MOTIONS, RETRAN-02/GRAV

(IMPROVEMENT OF RETRAN-02 AND EXPERIMENTAL ANALYSES)

January 1992

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Japan Atomic Energy Research Institute

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Development of Analysis Code for Thermal Hydro-dynamics of Marine Reactor under Multi-dimensional Ship Motions, RETRAN-02/GRAV (Improvement of RETRAN-02 and Experimental Analyses)

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We have improved a computer code RETRAN-02/GRAV for analysing thermal-hydro dynamics of a marine reactor plant under ship motions as a tool for research and development of marine reactor. The RETRAN-02 bases originally on one-dimensional model. Some improvement of the original RETRAN code has been made in analysis of thermal hydro-dynamics of a heaving (vertical movement) and a rolling (rotational movement), as well as a stationary inclination, on vertical acceleration by one-dimensional model, on inclination by two-dimensional model, on vertical and horizontal acceleration by two-dimensional model, and on arbitrary rotation by three-dimensional model.

We have checked the improved models by analyses of some experiments: single-phase and two-phase natural circulation flows under heaving, single-phase natural circulation with rolling and the single-phase natural circulation at stationary inclination attitude. The analyzed results verify the presented model to be capable to simulate well the ship motions.

As an application of RETRAN-02/GRAV, the nuclear powered ship Mutsu has been analysed to provide useful information for planning of the experiment in the Mutsu experimental voyage.

Keywords: Thermal Hydraulic Analysis, RETRAN-02, Marine Reactor, Ship Motion, Three-dimensiona, Mutsu Experimental Vapor, Heaving, Rolling

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多次元船体運動下での舶用炉熱水力挙動解析コード RETRAN-02/GRAVの開発
（RETRAN-02コードの改良及び実験解析）

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船体運動条件下での原子炉プラント熱水力挙動を解析できるRETRAN-02/GRAVを開発した。RETRAN-02コードはもともと一次元モデルを対象としているが，船体運動による原子炉プラント熱水力挙動への影響として，ヒービング（上下動加速度運動），ローリング（横揺れ運動）及びピッチング（縦揺れ運動），ならびに船体定傾斜の組合せが考慮できるよう多次元モデルへの拡張を行った。

この改良したコードの機能を，これまで行われたいくつかの実験，すなわち，ヒービング状態での単相及び二相自然循環実験，ローリング状態下での単相自然循環実験，及び定傾斜状態下での単相自然循環実験について解析を行い，十分実験結果を模擬できることを明らかにした。

実機への応用として，船体運動が原子力「むつ」炉に及ぼす影響を把握するために，ヒービング，ローリング及び定傾斜状態でのプラント挙動を解析し，「むつ」実験航海の実験海域の条件選定に役立てた。

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1. Introduction

The marine reactor plant is influenced thermal-hydraulically by various ship motions. There are six ship motions caused mainly by swell, wind wave or ship maneuvering : heaving, swaying, surging, pitching, rolling, and yawing as shown in Fig. 1.1 The former three are linear motions and the latter three are rotational motions. Thermal-hydraulic behavior of a marine reactor is influenced by ship stationary inclining as well as by above mentioned ship motions. The effects of heaving, rolling and stationary inclining are dominant in ship motions and very important for design and operation of marine reactors.

Although several experimental studies have been found about the effect of heaving on the critical heat flux[1-3] and about the effect of heaving or rolling on natural circulation flow in the primary side[4-6], little research has so for been conducted on analytical research i.e. code development.

We have improved the RETRAN-027) so as to be capable of simulating the thermal hydraulic transients under ship motions, named RETRAN-02/GRAV in order to apply to designing future marine reactors, and to analysis of the first Japanese nuclear powered ship N.S. Mutsu for predicting the transient behavior in her experimental voyages.

N.S. Mutsu had been tested with heavy load changes during power-up test from March 29th to December 14th of 1990, and accordingly JAERI got the operational licence of Mutsu reactor. Experimental voyages commenced on February 25 of 1991 to obtain mainly the data upon the effect of ship motion and ship maneuvering on the reactor under four sea states : calm sea, ordinary sea, rough sea and tropical sea.

Some of the Mutsu power-up test have been analysed using RETRAN-02/GRAV code developed by us and a good agreement between the tests and the RETRAN-02/GRAV analyses have been obtained. The power-up test was performed in the calm sea condition, although the effects of the ship motions on reactor were small. The experimental voyages are scheduled to be done on various sea conditions in order to study the effects of ship motions on scheduled to be done on various sea conditions in order to study the effects of ship motions and ship maneuverings on reactor. The analyses of Mutsu reactor using RETRAN-02/GRAV have been done to provide quantitative information for planning of the experiment in the Mutsu experimental voyage.

Present report describes the improvements in RETRAN-02/GRAV, the verification through some experiments, and the analyses of the Mutsu experimental voyage. The report includes the following items :

a. improvement for stationary inclination,
b. improvement for heaving,
c. improvement for rolling,
d. improvement for three-dimensional ship motion,
e. verification through experiment under stationary inclination,
f. verification through experiments under heaving,
g. verification through experiment under rolling, and
h. analyses of N.S. Mutsu reactor under ship motions.

We believe that the present code improvement for simulation of two-dimensional motion and three-dimensional ship movement is a first trial over the world as an expansion of large thermal hydro-dynamic code RETRAN which bases on one-dimensional analysis with a node-junction method for general use.

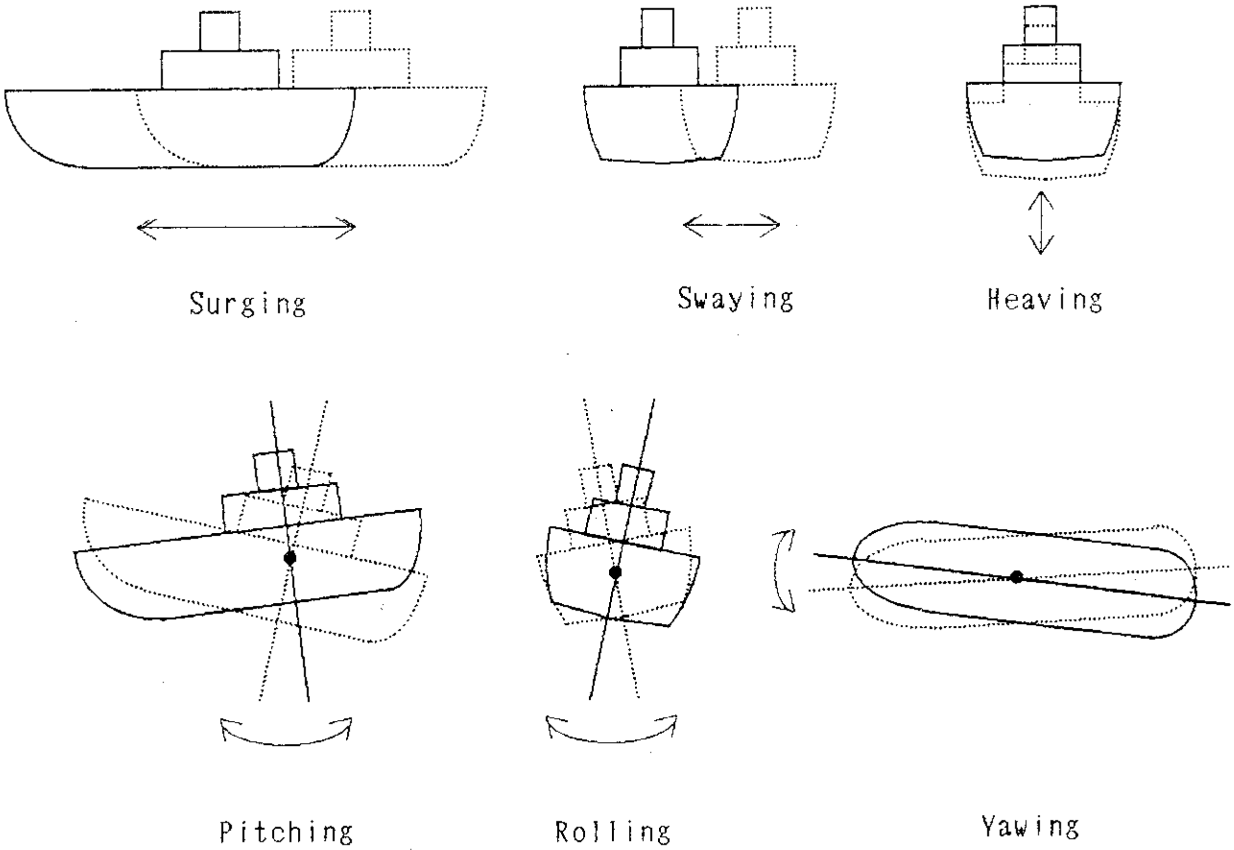

Fig. 1.1 Six Types of Ship Motion

2. Description of Improvement in RETRAN-02/GRAV Code

The RETRAN-02 is a code widely used for best-estimate transient thermal-hydraulic analysis of light water reactor systems. The RETRAN code has been originally developed based on the RELAP4/003 UPDATE 85 code and by by taking up the function of control logic in to the RELAP/E code which has been improved mainly using the experimental data. We have improved the RETRAN-02 code to be capable of simulating some ship motions : We named it RETRAN-02 /GRAV code.

The technical nomenclature found in the following equations were listed in in pages 81 and 82.

2.1 Basic Conservation Equations and Model Geometry in RETRAN-02

In the RETRAN-02, the fluid balance equations of mass, momentum and energy are based on the integral macroscopic balances between average flow and state of fluid volume. These equations are applied to volume-junction (or (or node-flowpass) basis, as illustrated in Fig. 2.1.1 (see reference[7] for the the details). A hydraulic network can be represented by a number of control control volumes connected by junctions. While the conservation equations for for mass and energy and the state equation are applied to each volume, the momentum equation is applied to the junction. That is , the staggered mesh method is adopted in the RETRAN. The geometry of the volume is taken as a straight tube. Thus, the geometric characteristics of the network must be supplied in the RETRAN-02 based on the fixed spatial locations.

The conservation equations of mass and energy are scalar equations and then the sign of mass flow rate is very important. With the mass inflow at point point 'i-1' and the mass outflow at point 'i', the conservation equation of of mass for volume 'k' is given as follows :

$$\frac{dM_k}{dt} = W_{i-1} - W_i, \tag{2.1.1}$$

where,

$$M_k = \bar{\rho}_k V_k, \tag{2.1.1a}$$

$$W_{i-1} = (\rho A v)_{i-1}, \tag{2.1.1b}$$

and

$$W_i = (\rho A v)_i \tag{2.1.1c}$$

The conservation of energy for volume 'k' is also given as follows:

$$\frac{dU_k}{dt} = -\frac{1}{2}\frac{L_k}{A_k}\frac{d}{dt}\left(\frac{\bar{W}_k^2}{\rho_k}\right) + W_{i-1}\left[h_{i-1} + \left(\frac{W^2}{\rho A}\right)_{i-1} + g\,(Z_{i-1} - Z_k)\right]$$
$$- W_i\left[h_i + \left(\frac{W^2}{\rho A}\right)_i + g\,(Z_i - Z_k)\right] + Q_{wm}, \tag{2.1.2}$$

where,

$$U_k = M_k u_k, \tag{2.1.2a}$$

$$\bar{W}_k = \bar{\rho}_k A_k v_k. \tag{2.1.2b}$$

The pressure in the volume 'k' is obtained from the mass and energy.

$$P_k = P_k(M_k, U_k). \tag{2.1.2c}$$

These conservation laws are a general representation of mass and energy for for control volume.

Next, the following momentum equation for a homogeneous mixed flow is given given by assuming that all the directions of inflow and outflow are perpendicular to, respectively, the surfaces 'Ak' and 'Ai'.

$$\left[\frac{1}{2}\frac{L_k}{A_k}+\frac{1}{2}\frac{L_{k+1}}{A_{k+1}}\right]\frac{dW_i}{dt}=\frac{\bar{W}_k^2}{\rho_k A_k^2}-\frac{\bar{W}_{k+1}^2}{\rho_{k+1}A_{k+1}^2}+P_k-P_{k+1}$$
$$-\frac{1}{A_k}F_{w,k}-\frac{1}{A_{k+1}}F_{w,k+1}$$
$$-\bar{\rho}_k(Z_i-Z_k)\,g_{z,k}-\bar{\rho}_{k+1}(Z_{k+1}-Z_i)\,g_{z,k+1}$$
$$+\frac{1}{2}\frac{W_i^2}{\rho_i}\left[\frac{1}{A_{k+1}^2}-\frac{1}{A_k^2}\right]-\frac{1}{2}W_i|W_i|\frac{e_i}{\rho_i A_i^2}, \qquad (2.1.3)$$

where the first and the second terms in the right hand are the momentum flux, flux, the sum of the third and the fourth terms are the pressure difference, the fifth and the sixth terms are the wall frictions, the seventh and the eighth eighth terms are the water head, and the sum of the ninth and the tenth terms terms is the dynamic energy balance.

These equations used in the RETRAN-02 are based on the one-dimensional model. In the RETRAN-02/GRAV these equations will be modified to consider ship motion simulation as shown in the following sections. Keep in mind in simulation of ship motions that the relative positions of the control volumes and volumes and junctions do not change, even when the whole system changes owing to ship motions : the solid state model is maintained through transient.

2.2 Stationary Inclination

2.2.1 Analytical Model

The stationary inclination of ship (called as heeling) changes the vertical vertical height and the elevation of the volume and junction which are originally fixed to an initial spatial location used in the RETRAN-02. Three analytical models to be modified are shown in the following.

(1) Vertical volume

Figure 2.2.1 shows a simple vertical tube, which is modelled as a RETRAN noding (see Fig. 2.2.2). When the tube is inclined at degrees of θ as shown in in Fig. 2.2.3, the actual volume height changes from L to L $\cdot \cos\theta$ while the volume inventory and flow area remain the same ones (see Fig. 2.2.4).

(2) Horizontal volume

Figure 2.2.5 shows a simple horizontal tube which is modelled as a RETRAN noding (see Fig. 2.2.6). The horizontantal tube, which does not have substantial volume height from the beginning in the RETRAN noding, will have have the vertical height by inclination of the volume. When the tube is inclined inclined at the degree of θ as shown in Fig. 2.2.7, a relationship between upper upper and lower sides in the volume ends should be taken account : The volume volume height changes from zero to $-L \cdot \sin\theta$ viewing from the left side and to to $L \cdot \sin\theta$ viewing from the right side, as shown in Fig. 2.2.8.

(3) Water level

Water level is modelled in a RETRAN volume as shown in Fig. 2.2.9. Steam flows out through the junction J1 of which elevation is higher than the water water level. Water flows out through the junction J2 of which elevation is lower lower than the water level. In inclination it sometimes happens to occur that that the junction J1 becomes lower than the water level or the junction J2 becomes higher than the water level as shown in Fig. 2.2.10. This means that an an entalphy of junction flow will change also by inclination.

Those models are taken into the momentum and the energy equations, as shown in the following.

2.2.2 Momentum Equation

The water head term in the momentum equation of RETRAN should be modified modified as follows. The water head is represented as head from the center of of upstream volume to the center of downstream volume. For example, as shown in Fig. 2.2.11 the water head is given as follows:

$$H = -\bar{\rho}_k\ (Z_i - Z_k)\ g_z - \bar{\rho}_{k+1}\ (Z_{k+1} - Z_i)\ g_z$$

$$= \bar{\rho}_1\ \{c_1 - (e_j - e_1)\}\ g_z - \bar{\rho}_2\ \{c_2 - (e_j - e_2)\}\ g_z, \quad (2.2.1)$$

where ci is the height from bottom to center of volume i, ei is the height from a from a base line to the bottom of the volume i or of a junction level. That is, the is, the water head is the vertical length between volumes or junctions.

We consider the volume configuration shown in Fig. 2.2.12. The blank circle circle marks are the junction levels and the solid circle mark is the geometric geometric center of volume. Length RELZl is the height of junction connected connected to the volume from left side, RELZr from right side, and CMAS is the the height of volume center. Inclination of the volume configuration is represented in Fig. 2.1.13. Actual height changes from RELZl to RELZl ′, from from RELZr to RELZr ′, and from CMAS to CMAS ′ according to inclination. We We have introduced a new parameter of the horizontal volume length BOT. Relationship of the length between before and after inclination is given using using BOT and θ as follows:

$$\mathrm{CMAS}' = \mathrm{CMAS} \cdot \cos\theta \ , \tag{2.2.2}$$

$$\mathrm{RELZl}' = \mathrm{RELZl} \cdot \cos\theta + 0.5 \cdot \mathrm{BOT} \cdot \sin\theta, \tag{2.2.3}$$

$$\mathrm{RELZr}' = \mathrm{RELZr} \cdot \cos\theta - 0.5 \cdot \mathrm{BOT} \cdot \sin\theta. \tag{2.2.4}$$

We need to define whether a junction should be connected to the right side side or left side of the volume, since the original one-dimensional RETRAN code code can not distinguish the sides of the volume. In the RETRAN-02/GRAV a new parameter of flag 'iflag' is introduced. With 'iflag', the length of RELZl ′ and RELZr ′ are given as follows:

$$\mathrm{RELZ}' = \mathrm{RELZ} \cdot \cos\theta + 0.5 \cdot \mathrm{BOT} \cdot \sin\theta \cdot \mathrm{iflag}. \tag{2.2.5}$$

The parameter 'iflag' is set to +1 for the junction of which position goes goes upward (as RELZl ′ in Fig. 2.2.13) and to -1 for the junction downward (see RELZr ′ in the figure). If a position of junction is the top or bottom of of the volume, the 'iflag' is set to zero.

2.2.3 Energy Equation

Elevation energy term and flow-out entalphy term from junction should be be modified. The elevation energy term is treated the same as the water head term in the momentum equation. The flow-out entalphy term is described for the volume with water level as follows.

Figure 2.2.14 shows the water level in the upright state. The water level is is ZM from the bottom. Blank circle marks are the positions of junction. Steam Steam flows out through the junction of which level is higher than the water level and saturated water flows out through the junction lower than the water water level. When the volume inclines by degree of θ as shown in Fig. 2.2.15, the water level changes from ZM to ZM ′, and the junction positions change from RELZl to RELZl ′, and from RELZr to RELZr ′. The water level ZM ′ is given by ZM and θ. That is,

$$ZM' = ZM \cdot \cos\theta. \qquad (2.2.6)$$

Comparing the RELZl ′ or RELZr ′ to ZM ′, the junction entalphy can be decided by whether the junction property is steam or saturated water.

2.3 Heaving

Heaving gives a plant system a uniform time-dependent vertical acceleration. acceleration. This acceleration adds to the momentum equation and energy equation under the steady gravitational acceleration. We call the vertical acceleration due to heaving as g(t) and the gravitational acceleration as gz, and the ratio of g(t)/gz as the normalized acceleration β (t) in the present paper.

2.3.1 Momentum Equation

The momentum equation (see Eq. 2.1.3) is divided by gz to treat the pressure as engineering unit in RETRAN code as follows:

$$\frac{1}{g_z}\left[\frac{1}{2}\frac{L_k}{A_k}+\frac{1}{2}\frac{L_{k+1}}{A_{k+1}}\right]\frac{dW_i}{dt}=\left[\frac{\bar{W}_k^2}{\rho_k A_k^2}-\frac{\bar{W}_{k+1}^2}{\rho_{k+1}A_{k+1}^2}\right]\frac{1}{g_z}+P_k'-P_{k+1}'$$
$$+\left[-\frac{1}{A_k}F_{w,k}-\frac{1}{A_{k+1}}F_{w,k+1}\right]\frac{1}{g_z}$$
$$-\bar{\rho}_k(Z_i-Z_k)-\bar{\rho}_{k+1}(Z_{k+1}-Z_i)$$
$$+\left\{\frac{1}{2}\frac{W_i^2}{\rho_i}\left[\frac{1}{A_{k+1}^2}-\frac{1}{A_k^2}\right]-\frac{1}{2}W_i|W_i|\frac{e_i^*}{\rho_i A_i^2}\right\}\frac{1}{g_z}, \tag{2.3.1}$$

where the relationship of $g_{z,k}=g_{z,k+1}=g_z$ is used.

To take account of the uniform time-dependent vertical acceleration g(t), we g(t), we replace the $g_{z,k}$ and $g_{z,k+1}$ with g(t) in the Eq. 2.1.3. Thus, we obtain, obtain,

$$\left[\frac{1}{2}\frac{L_k}{A_k}+\frac{1}{2}\frac{L_{k+1}}{A_{k+1}}\right]\frac{dW_i}{dt}=\frac{\bar{W}_k^2}{\rho_k A_k^2}-\frac{\bar{W}_{k+1}^2}{\rho_{k+1}A_{k+1}^2}+P_k'-P_{k+1}'$$
$$-\frac{1}{A_k}F_{w,k}-\frac{1}{A_{k+1}}F_{w,k+1}$$
$$-\bar{\rho}_k(Z_i-Z_k)\,g(t)-\bar{\rho}_{k+1}(Z_{k+1}-Z_i)\,g(t)$$
$$+\frac{1}{2}\frac{W_i^2}{\rho_i}\left[\frac{1}{A_{k+1}^2}-\frac{1}{A_k^2}\right]-\frac{1}{2}W_i|W_i|\frac{e_i^*}{\rho_i A_i^2}, \tag{2.3.2}$$

Dividing both sides of Eq. 2.3.2 by gz, the following equation is obtained.

$$\frac{1}{g_z}\left[\frac{1}{2}\frac{L_k}{A_k}+\frac{1}{2}\frac{L_{k+1}}{A_{k+1}}\right]\frac{dW_i}{dt}=\left[\frac{\bar{W}_k^2}{\rho_k A_k^2}-\frac{\bar{W}_{k+1}^2}{\rho_{k+1}A_{k+1}^2}\right]\frac{1}{g_z}+P_k'-P_{k+1}'$$
$$+\left[-\frac{1}{A_k}F_{w,k}-\frac{1}{A_{k+1}}F_{w,k+1}\right]\frac{1}{g_z}$$
$$-\left[\bar{\rho}_k(Z_i-Z_k)+\bar{\rho}_{k+1}(Z_{k+1}-Z_i)\right]\frac{g(t)}{g_z}$$
$$+\left\{\frac{1}{2}\frac{W_i^2}{\rho_i}\left[\frac{1}{A_{k+1}^2}-\frac{1}{A_k^2}\right]-\frac{1}{2}W_i|W_i|\frac{e_i^*}{\rho_i A_i^2}\right\}\frac{1}{g_z}. \qquad (2.3.3)$$

Comparing to Eq. 2.3.1, it is found that the water head term in the Eq. 2.3.3 is multiplied by g(t)/gz. The pressure terms of Eq. 2.3.1 remain as the the same as in the Eq. 2.3.3. The pressure is not affected by even gravitational gravitational acceleration change since the pressure term in Eq. 2.1.3 is a parameter of the absolute unit in the general steam table.

As a result, the momentum equation for heaving can be represented by multiplying by β (t) (= g(t)/gz) to the water head term in the original RETRAN RETRAN equation. In the code, the water head is obtained in the subroutine HEADC and it is used by multiplying by β (t).

2.3.2 Energy Equation

The gravitational acceleration relates to only the elevation energy term in term in Eq. 2.1.2. Hence the energy equation for heaving is obtained by replacing gz with g(t) in the Eq. 2.1.2. Thus, we obtain,

$$\frac{dU_k}{dt}=-\frac{1}{2}\frac{L_k}{A_k}\frac{d}{dt}\left(\frac{\bar{W}_k^2}{\rho_k}\right)+W_{i-1}\left[h_{i-1}+\left(\frac{W^2}{\rho A}\right)_{i-1}+g(t)(Z_{i-1}-Z_k)\right]$$
$$-W_i\left[h_i+\left(\frac{W^2}{\rho A}\right)_i+g(t)(Z_i-Z_k)\right]+Q_{wm}. \qquad (2.3.4)$$

In modification of the code the $g_{z(t)}$ is replaced with $g_z \cdot \beta(t)$.

2.3.3 Time-Dependent Acceleration

Acceleration due to heaving can be represented for a simple periodical oscillation as follows.

$$g(t) = g_z \cdot \left(1 + A \cdot \sin\left(\frac{2\pi}{T_g} t\right)\right), \tag{2.3.5}$$

$$\beta(t) = 1 + A \cdot \sin\left(\frac{2\pi}{T_g} t\right), \tag{2.3.6}$$

where A is the amplitude, and Tg is the period of oscillation. It is convenient in practice to use the control logic system of RETRAN for simulation of the normalized acceleration $\beta(t)$.

2.4 Rolling

Rolling is a kind of rotation which gives the plant system a time-dependent inclination with a centrifugal force and a tangential force. Figure 2.4.1 shows a schematic diagram of the volume under rolling. The time-dependent inclination of the volume by rolling can be represented by the same way as the stationary inclination except the time-dependency.

The tangential force which is zero for the rotation with iso-angular velocity usually is predominant in rolling. The fluid of the unit mass in the volume receives the centrifugal force as a function of angular velocity and the length from the center of rotation to the volume, that is $R\dot{\theta}^2$ as shown in the figure. The tangential force is a function of angular acceleration and length from the center of rotation to the volume, that is, $R\ddot{\theta}$.

These forces can be divided into the vertical and the horizontal components as follows.

$$f_v = R\dot{\theta}^2 \cos\theta - R\ddot{\theta}\sin\theta, \tag{2.4.1}$$

$$f_h = R\dot{\theta}^2 \sin\theta + R\ddot{\theta}\cos\theta. \tag{2.4.2}$$

The force fV acts downward on the fluid as shown in the Fig. 2.4.1 when the volume is below than the center of rotation, and the force fV acts upward when the volume is above the center of rotation.

2.4.1 Momentum Equation

Rolling is the two-dimensional rotational motion. Since the RETRAN model is originally based on one-dimension, the two-dimensional forces, the vertical force and the horizontal force should be taken in account newly for rolling.

The vertical force f_v can add to the water head term in the momentum equation. On the other hand, there is not a horizontal water head term for the horizontal force f_h in the original RETRAN equation. We introduce the horizontal term using the horizontal length of the volume for tangential force BOT・cos θ, where θ is the angle of volume to the horizontal axis.

$$
\begin{aligned}
\frac{1}{g_z}\left[\frac{1}{2}\frac{L_k}{A_k}+\frac{1}{2}\frac{L_{k+1}}{A_{k+1}}\right]\frac{dW_i}{dt} = & \left[\frac{\bar{W}_k^2}{\rho_k A_k^2} - \frac{\bar{W}_{k+1}^2}{\rho_{k+1} A_{k+1}^2}\right]\frac{1}{g_z} + P'_k - P'_{k+1} \\
& + \left[-\frac{1}{A_k}F_{w,k} - \frac{1}{A_{k+1}}F_{w,k+1}\right]\frac{1}{g_z} \\
& - \left[\bar{\rho}_k (Z_i - Z_k) + \bar{\rho}_{k+1} (Z_{k+1} - Z_i)\right]\frac{g(t)+f_v}{g_z} \\
& - \frac{1}{2}\left[\bar{\rho}_k \cdot BOT_k \cdot \cos\theta + \bar{\rho}_{k+1} \cdot BOT_{k+1} \cdot \cos\theta\right]\frac{f_h}{g_z} \\
& + \left\{\frac{1}{2}\frac{W_i^2}{\rho_i}\left[\frac{1}{A_{k+1}^2} - \frac{1}{A_k^2}\right] - \frac{1}{2}W_i |W_i| \frac{e_i}{\rho_i A_i^2}\right\}\frac{1}{g_z},
\end{aligned}
\tag{2.4.3}
$$

For the vertical volume, the tangential force is zero (θ =90°, ∴ cos θ =0) and for the horizontal volume, the force is 0.5・BOT・A・ρ・f_h (θ =0°, ∴ cos θ =1).

2.4.2 Energy Equation

The horizontal head due to the tangential force together with the vertical force should be taken in energy equation. The elevation energy term are represented using the vertical and horizontal terms as follows:

$$\frac{dU_k}{dt} = -\frac{1}{2}\frac{L_k}{A_k}\frac{d}{dt}\left(\frac{\bar{W}_k^2}{\rho_k}\right) + Q_{wm}$$
$$+ W_{i-1}\left[h_{i-1} + \left(\frac{W^2}{\rho A}\right)_{i-1} + (g(t)+f_v)\quad(Z_{i-1}-Z_k) + \frac{1}{2} f_h \cdot BOT_k \cdot \cos\theta\right]$$
$$- W_i\left[h_i + \left(\frac{W^2}{\rho A}\right)_i + (g(t)+f_v)\quad(Z_i-Z_k) - \frac{1}{2} f_h \cdot BOT_k \cdot \cos\theta\right], \tag{2.4.4}$$

where the length of $1/2 \cdot BOT \cdot \cos\theta$ is used for the horizontal energy term. For the vertical volume, the horizontal energy term is zero, and for the horizontal volume, the energy term is $1/2 \cdot BOT \cdot f_h \cdot W$.

2.5 Three-Dimensional Motions

The ship motion practically works in three-dimensional movement since rolling and pitching do simultaneously. It is necessary to be capable of treating three-dimensional motion for estimation of the effect of real ship motion on the reactor plant system. We have improved that the RETRAN-02/GRAV can simulate the three-dimensional motions due to rolling and pitching in an arbitrary planes.

2.5.1 Modelling of Three-Dimensional Movement

(1) Rotation of co-ordinates

Let consider the vector OP(x,y,z), in the three-dimensional rectangular co-ordinate as shown in Fig. 2.5.1. The OP is taken as the volume of which the point 0 fixed at the origin shows the flow inlet, and the point P the flow outlet. The length of volume is γ. Each components of the vector to the x, y, z axes are

$$x = \gamma \cos\theta \cdot \cos\phi,$$
$$y = \gamma \cos\theta \cdot \sin\phi, \qquad (2.5.1)$$
$$z = \gamma \sin\theta.$$

where $\phi = \angle xoy$, $\theta = \angle QOP$. The vector can move arbitrarily in the three-dimensional co-ordinates corresponding to ship motions with fixing the point 0 to the origin while the relationship between the volumes or junctions remains as the initial state. The movement of vector can be represented by rotations around each x axis, y axis, and z axis. The co-ordinate of point P(x,y,z) after rotation around each axis are obtained as follows.

First, when the vector rotates around z-axis by angle of ϕ_z the point P moves to Pz(xz, yz, zz). As shown in Fig. 2.5.2, the length of OP mapped on the xoy plane is rxy(= $\gamma \cos\theta$). The components xz, yz, zz are given as follows:

$$x_z = x\cos\phi_z - y\sin\phi_z, \qquad (2.5.2)$$
$$y_z = y\cos\phi_z + x\sin\phi_z, \qquad (2.5.3)$$
$$z_z = z. \qquad (2.5.4)$$

Hence, the rotation around z-axis is represented by the matrix form.

$$\begin{bmatrix} x_z \\ y_z \\ z_z \end{bmatrix} = \begin{bmatrix} \cos\phi_z & -\sin\phi_z & 0 \\ \sin\phi_z & \cos\phi_z & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}. \qquad (2.5.5)$$

Next, when the vector rotates around y-axis by angle of θ_y, the point P moves to Py(xy, yy, zy). As shown in Fig. 2.5.3, the length of OP mapped on the xoz plane is taken as rxz. The components xy, yy, zy are given as follows:

$$x_y = x\cos\theta_y - z\sin\theta_y, \qquad (2.5.6)$$
$$z_y = z\cos\theta_y + x\sin\theta_y, \qquad (2.5.7)$$
$$y_y = y. \qquad (2.5.8)$$

Hence, the rotation around y-axis is represented by the matrix form.

$$\begin{bmatrix} x_y \\ y_y \\ z_y \end{bmatrix} = \begin{bmatrix} \cos\theta_y & 0 & -\sin\theta_y \\ 0 & 1 & 0 \\ \sin\theta_y & 0 & \cos\theta_y \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} . \tag{2.5.9}$$

Finally, when the vector rotates around x-axis by angle of ζ_x the point P moves to Px(xx, yx, zx). As shown in Fig. 2.5.4, the length of OP mapped on the xoz plane is ryz. The components xx, yx, zx are given as follows:

$$z_x = z\cos\zeta_x - y\sin\zeta_x , \tag{2.5.10}$$

$$y_x = y\cos\zeta_x + z\sin\zeta_x , \tag{2.5.11}$$

$$x_x = x . \tag{2.5.12}$$

Hence, the rotation around x-axis is represented by the matrix form.

$$\begin{bmatrix} x_x \\ y_x \\ z_x \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\zeta_x & \sin\zeta_x \\ 0 & -\sin\zeta_x & \cos\zeta_x \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} . \tag{2.5.13}$$

The rotations of vector around z-axis by ϕ_z, around y-axis by θ_y, and around x axis by ζ_x are summarized as the matrix form.

$$\begin{bmatrix} X' \\ Y' \\ Z' \end{bmatrix} = \begin{bmatrix} \cos\phi_z & -\sin\phi_z & 0 \\ \sin\phi_z & \cos\phi_z & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \cos\theta_y & 0 & -\sin\theta_y \\ 0 & 1 & 0 \\ \sin\theta_y & 0 & \cos\theta_y \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\zeta_x & \sin\zeta_x \\ 0 & -\sin\zeta_x & \cos\zeta_x \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} . \tag{2.5.14}$$

The original position of the vector are set by three-dimensional co-ordinates. Therefore, the position of the vector expressed by rotation of arbitrary angle can be obtained by Eq. 2.5.14. The vertical height of the vector changes from z to z ′ by rotations.

(2) Centrifugal and tangential forces

Rotation induces the position change as well as the centrifugal and tangential forces in the fluid volume. Rotation of z-axis makes the point P' of volume acceleration on the x-y plane as shown in Fig.2.5.5, where the distances from the origin are Rx on the x-axis, Ry on the y-axis, and Rz on the z-axis.

acceleration in centrifugal force : $\overline{OP}\,\dot{\phi}^2 = (Ry^2+Rx^2)^{1/2}\,\dot{\phi}^2$,
component of x-axis = $Rx\,\dot{\phi}^2$,
component of y-axis = $Ry\,\dot{\phi}^2$,

acceleration in tangential force : $\overline{OP}\,\ddot{\phi} = (Ry^2+Rx^2)^{1/2}\,\ddot{\phi}$,
component of x-axis = $Ry\,\ddot{\phi}$,
component of y-axis = $-Rx\,\ddot{\phi}$.

The rotation of y-axis makes forces on the z-x plane as shown in Fig. 2.5.6.

acceleration in centrifugal force : $\overline{OP}\,\dot{\theta}^2 = (Rz^2+Rx^2)^{1/2}\,\dot{\theta}^2$,
component of x-axis = $Rx\,\dot{\theta}^2$,
component of z-axis = $Rz\,\dot{\theta}^2$,

acceleration in tangential force : $\overline{OP}\,\ddot{\theta} = (Rz^2+Rx^2)^{1/2}\,\ddot{\theta}$,
component of x-axis = $Rz\,\ddot{\theta}$,
component of z-axis = $-Rx\,\ddot{\theta}$.

The rotation of x-axis makes forces on the y-z plane as shown in Fig. 2.5.7.

acceleration in centrifugal force : $\overline{OP}\,\dot{\zeta}^2 = (Ry^2+Rz^2)^{1/2}\,\dot{\zeta}^2$,
component of y-axis = $Ry\,\dot{\zeta}^2$.
component of z-axis = $Rz\,\dot{\zeta}^2$,

acceleration in tangential force : $\overline{OP}\,\ddot{\zeta} = (Ry^2+Rz^2)^{1/2}\,\ddot{\zeta}$,

component of y-axis = $-Rz\,\ddot{\zeta}$,

component of z-axis = $Ry\,\ddot{\zeta}$.

The acceleration components (α x, α y, α z) of x-axis, y-axis, and z-axis are summarized in the matrix form as follows:

$$\begin{bmatrix} \alpha_x \\ \alpha_y \\ \alpha_z \end{bmatrix} = \begin{bmatrix} \dot{\phi}^2+\dot{\theta}^2 & \ddot{\phi} & \ddot{\theta} \\ -\ddot{\phi} & \dot{\phi}^2+\dot{\zeta}^2 & -\ddot{\zeta} \\ -\ddot{\theta} & \ddot{\zeta} & \dot{\theta}^2+\dot{\zeta}^2 \end{bmatrix} \begin{bmatrix} Rx \\ Ry \\ Rz \end{bmatrix} . \qquad (2.5.15)$$

The distances of Rx, Ry, and Rz are obtained by multiplying the rotation matrix of co-ordinates (see Eq. 2.5.14) by initial co-ordinates of volume center.

2.5.2 Momentum Equation

The momentum equation for arbitrary tree-dimensional rotation is represented by the following equation:

$$\begin{aligned} \frac{1}{g_z}\left[\frac{1}{2}\frac{L_k}{A_k}+\frac{1}{2}\frac{L_{k+1}}{A_{k+1}}\right]\frac{dW_i}{dt} = {} & \left[\frac{\bar{W}_k^2}{\rho_k A_k^2} - \frac{\bar{W}_{k+1}^2}{\rho_{k+1} A_{k+1}^2}\right]\frac{1}{g_z} + P_k' - P_{k+1}' \\ & + [-\frac{1}{A_k}F_{w,k} - \frac{1}{A_{k+1}}F_{w,k+1} \quad \frac{1}{g_z} \\ & - [\bar{\rho}_k\,(Z_i-Z_k)' + \bar{\rho}_{k+1}\,(Z_{k+1}-Z_i)']\,\frac{g(t)+\alpha_z}{g_z} \\ & - \frac{1}{2}\,[\bar{\rho}_k\cdot\gamma_{k,x}+\bar{\rho}_{k+1}\cdot\gamma_{k+1,x}]\,\frac{\alpha_x}{g_z} \\ & - \frac{1}{2}\,[\bar{\rho}_k\cdot\gamma_{k,y}+\bar{\rho}_{k+1}\cdot\gamma_{k+1,y}]\,\frac{\alpha_y}{g_z} \\ & + \left\{\frac{1}{2}\frac{W_i^2}{\rho_i}\left[\frac{1}{A_{k+1}^2}-\frac{1}{A_k^2}\right] - \frac{1}{2}W_i|W_i|\frac{e_i}{\rho_i A_i^2}\right\}\frac{1}{g_z} . \end{aligned} \qquad (2.5.16)$$

To avoid the complexity of tree-dimensional analysis and taking account of practicality we can model two-dimensional component of the forces for the flows. That is, the acceleration (see Eq. 2.5.15) due to the centrifugal force and the tangential force are mapped to the x-z plane : α x, and α z. This formation is the same as the equation for rolling (see Eq. 2.4.3) except that the elevation and horizontal length in Eq. 2.5.16 are obtained by the rotation matrix of co-ordinates (see Eq. 2.5.14).

2.5.3 Energy Equation

Energy equation for arbitrary three-dimensional rotation is represented by the following equation.

$$\begin{aligned}\frac{dU_k}{dt} = &-\frac{1}{2}\frac{L_k}{A_k}\frac{d}{dt}\left(\frac{\bar{W}_k^2}{\rho_k}\right) + Q_{wm}\\ &+ W_{i-1}\ [h_{i-1} + \left(\frac{W^2}{\rho A}\right)_{i-1} + (g(t)+\alpha_z)\ (Z_{i-1}-Z_k)'\\ &\qquad + \frac{1}{2}\alpha_x\cdot\gamma_{k,x} + \frac{1}{2}\alpha_y\cdot\gamma_{k,y}\ ]\\ &- W_i\ [h_i + \left(\frac{W^2}{\rho A}\right)_i + (g(t)+\alpha_z)\ (Z_i-Z_k)'\\ &\qquad - \frac{1}{2}\alpha_x\cdot\gamma_{k,x} - \frac{1}{2}\alpha_y\cdot\gamma_{k,y}\ ] \ .\end{aligned} \tag{2.5.17}$$

This formation is also the same expression as the equation for rolling (Eq. 2.4.4), besides that the elevation and horizontal length in Eq. 2.5.17 are obtained by the rotation matrix of co-ordinates (see Eq. 2.5.14).

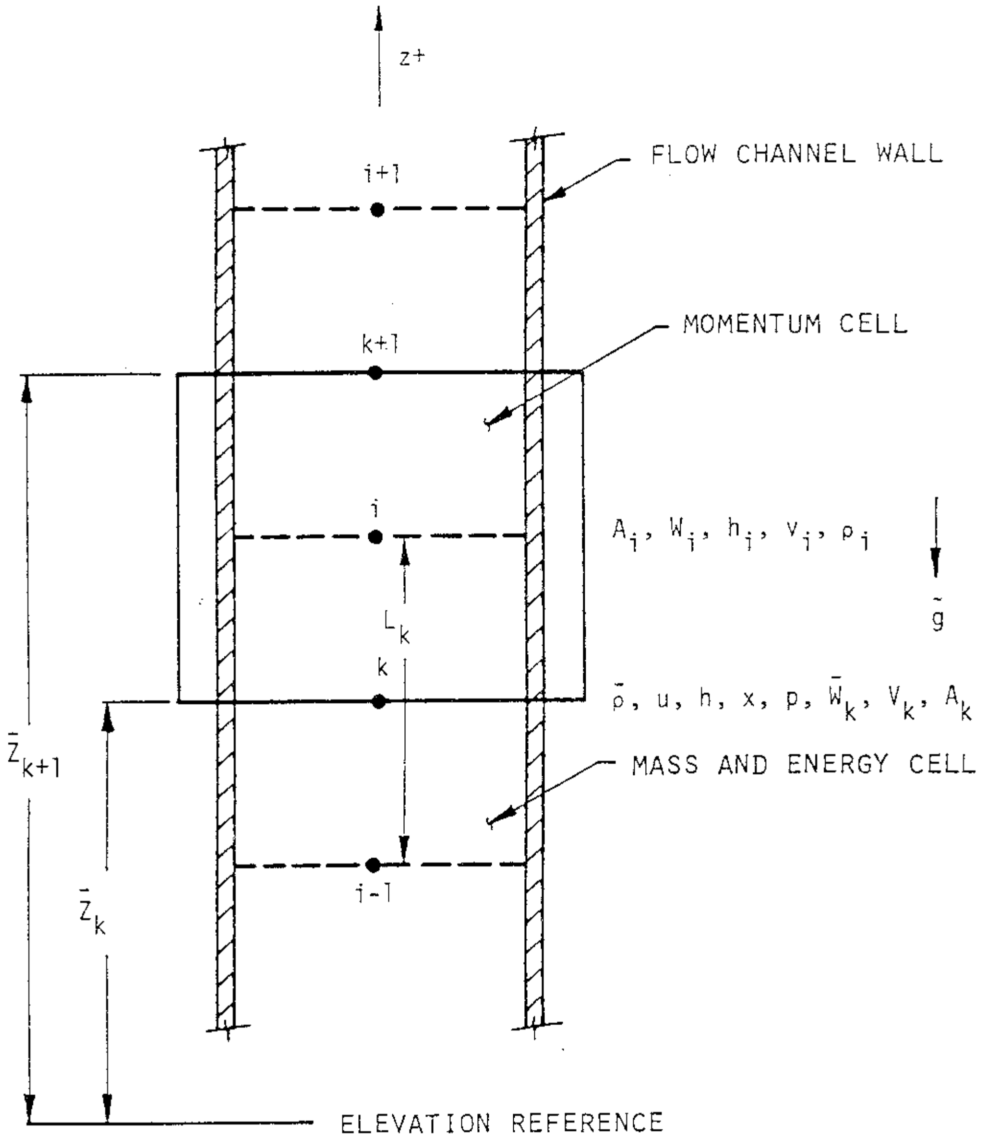

Fig. 2.1.1 Geometry for the RETRAN Equations (See reference(7) for detail)

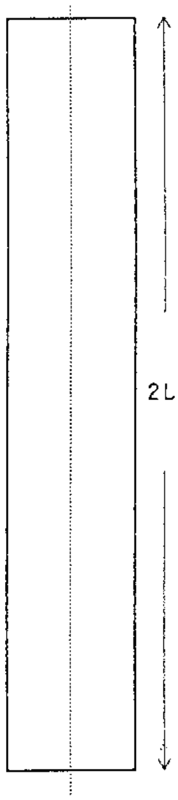

Fig. 2.2.1 Vertical Tube

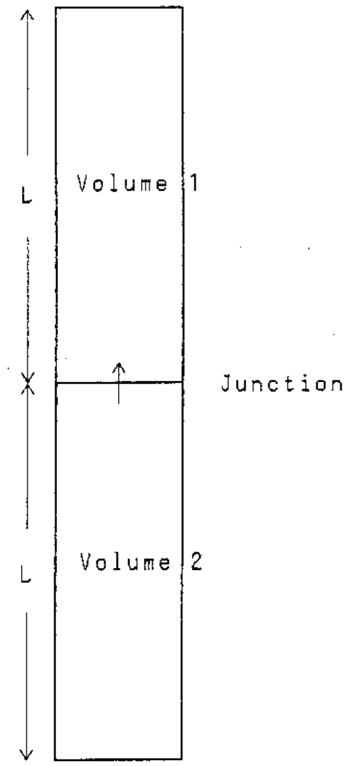

Fig. 2.2.2 RETRAN Noding Model

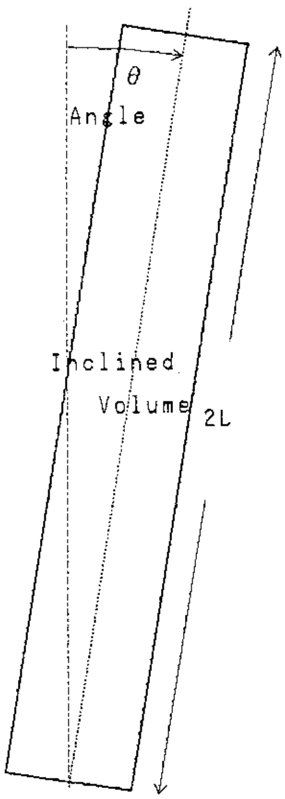

Fig. 2.2.3 Inclined Tube (Vertical Tube)

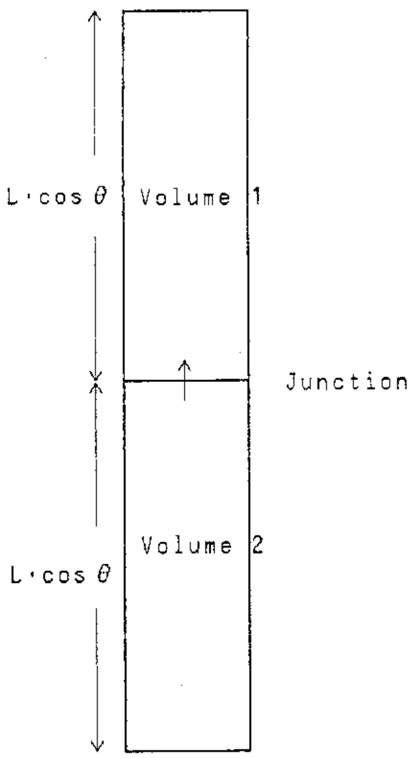

Fig. 2.2.4 RETRAN Noding Model for Inclined Vertical Tube

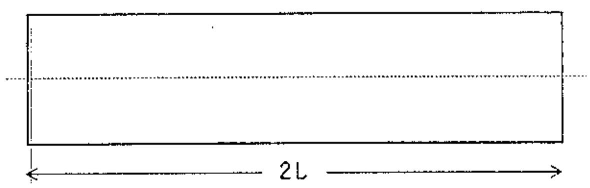

Fig. 2.2.5 Horizontal Tube

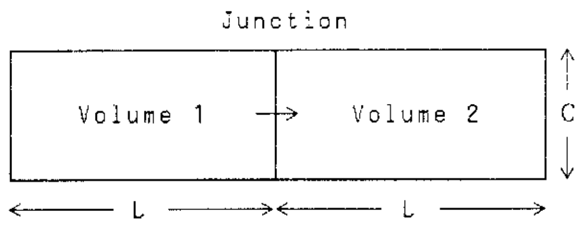

Fig. 2.2.6 RETRAN Noding Model for Horizontal Tube

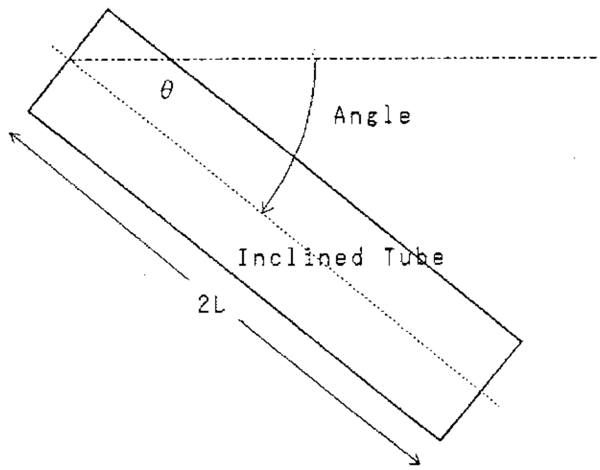

Fig. 2.2.7 Inclined Tube (Horizontal Tube)

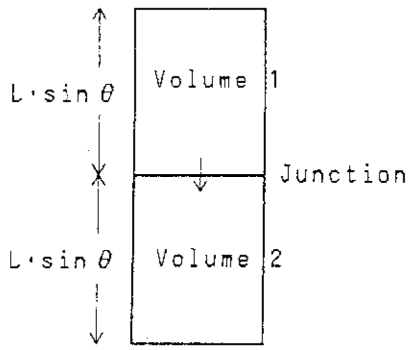

Fig. 2.2.8 RETRAN Noding Model for Inclined Horizontal Tube

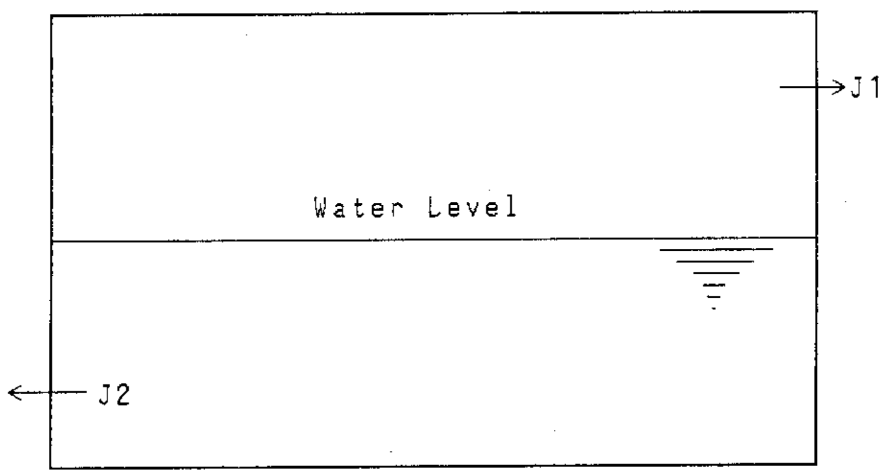

Fig. 2.2.9 Water Level Model

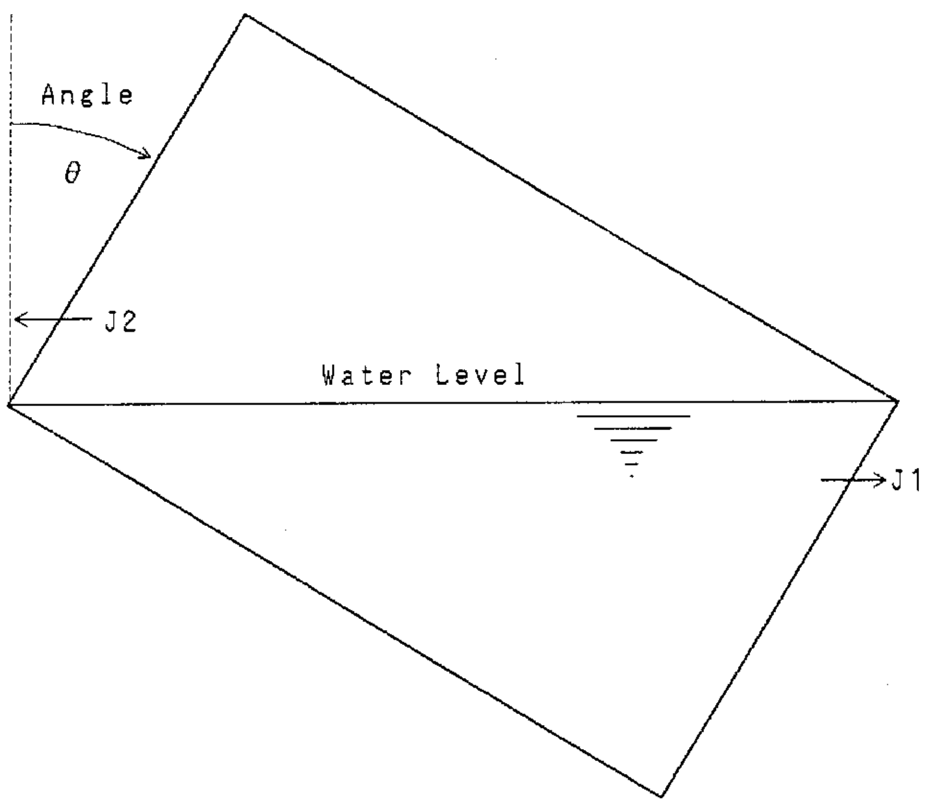

Fig. 2.2.10 Water Level Model at Inclination

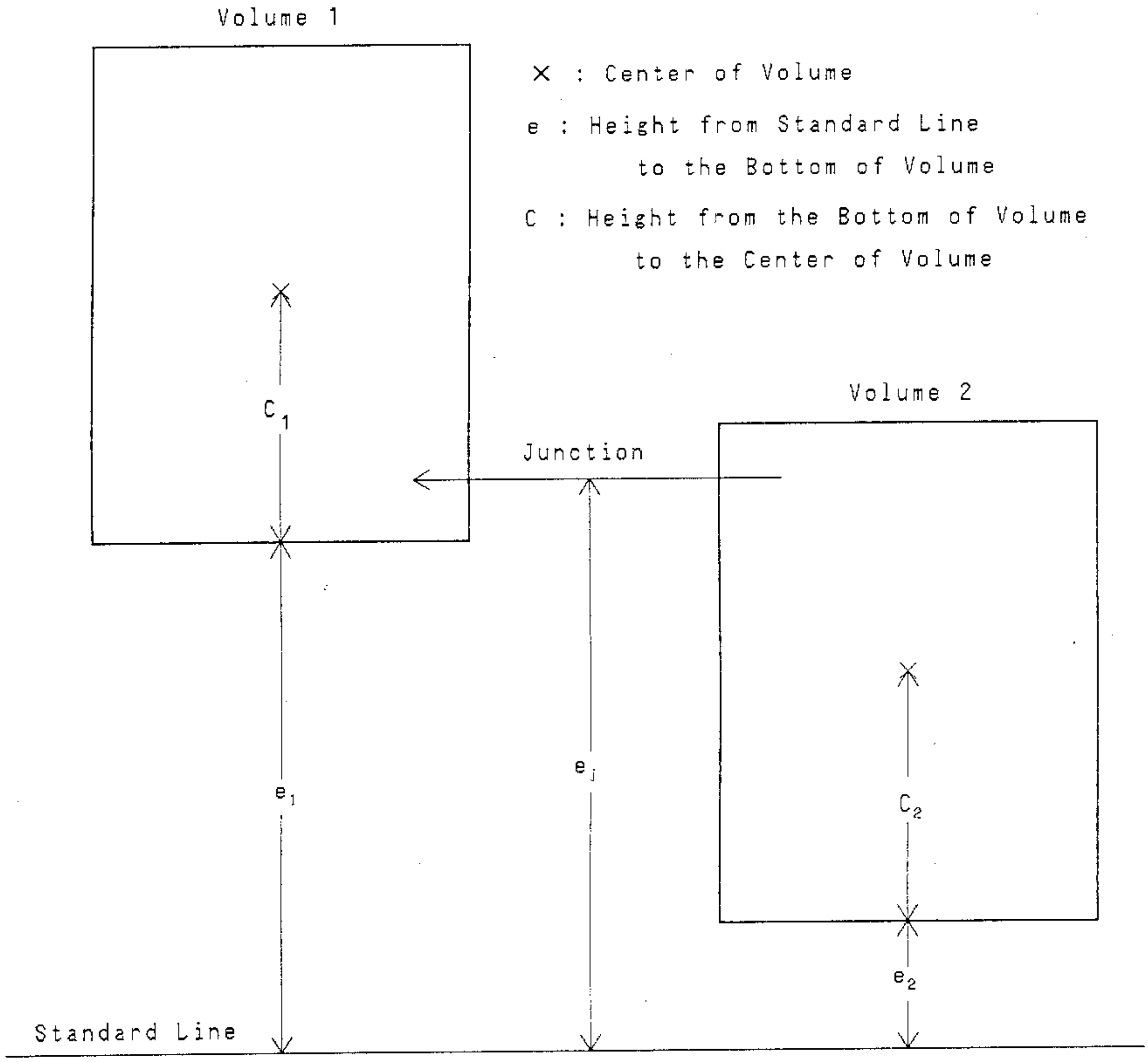

Fig. 2.2.11 Relationship of Elevation and Water Head in RETRAN Noding

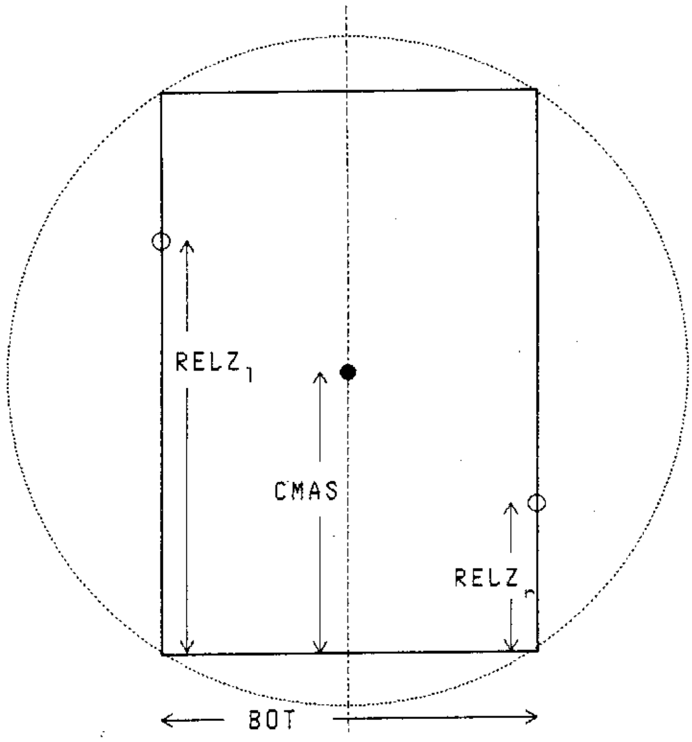

Fig. 2.2.12 Junction Elevation Before Inclination

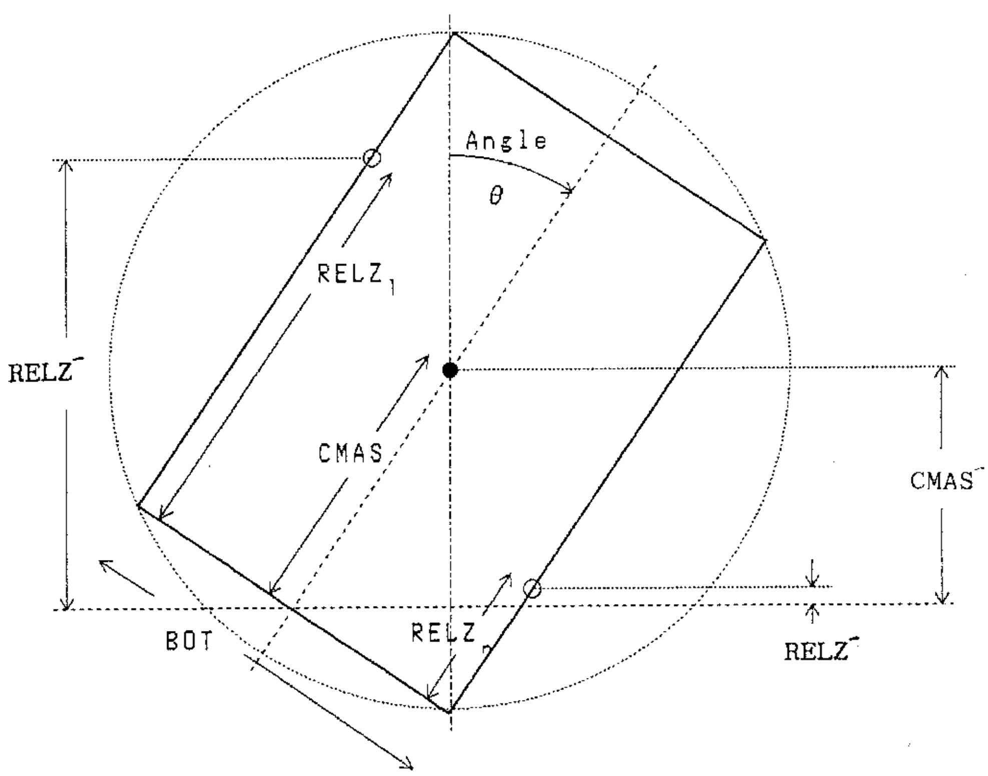

Fig. 2.2.13 Junction Elevation at Inclination

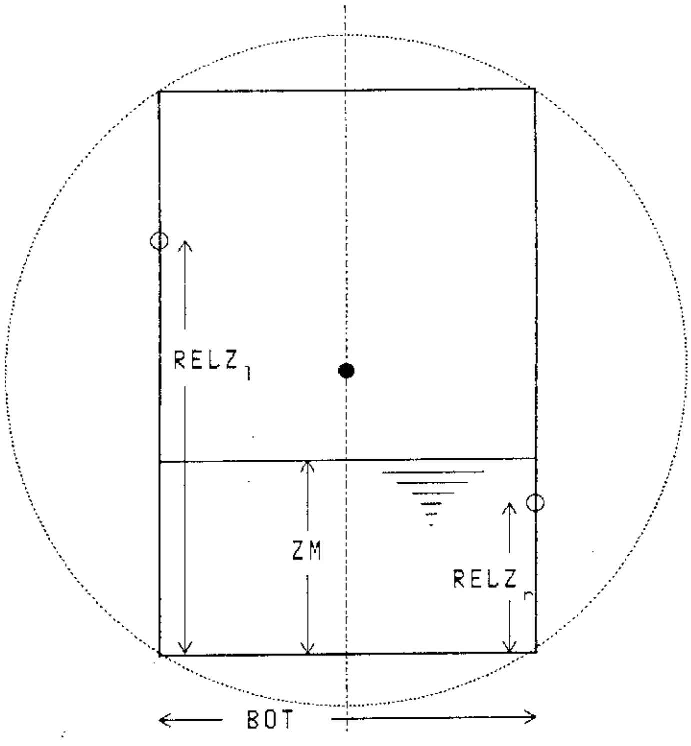

Fig. 2.2.14 Water Level Before Inclination

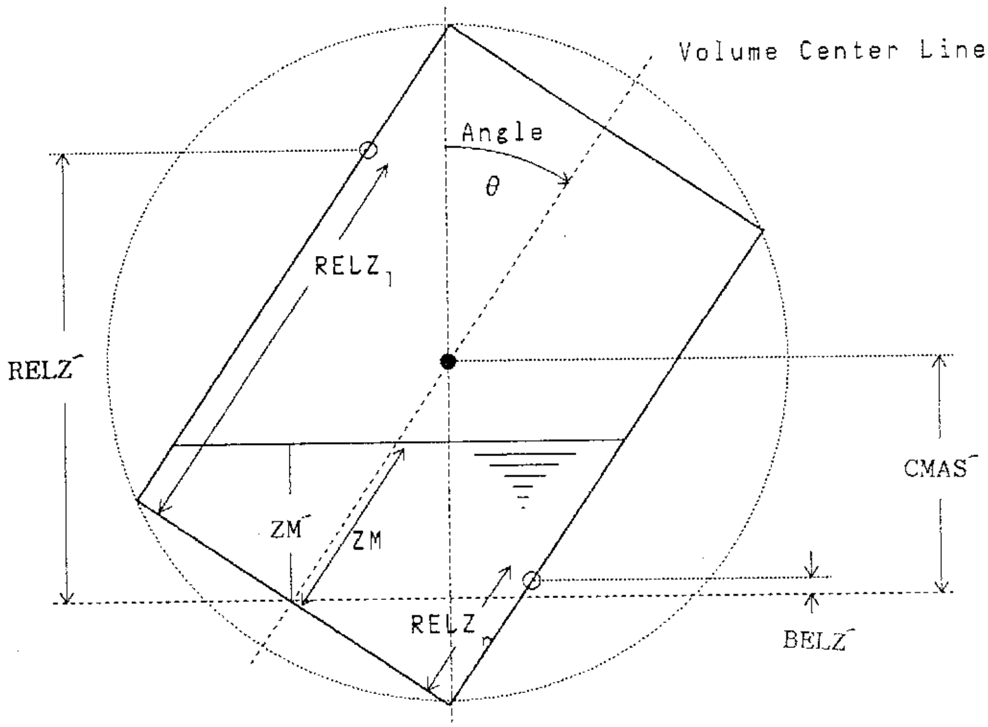

Fig. 2.2.15 Water Level at Inclination

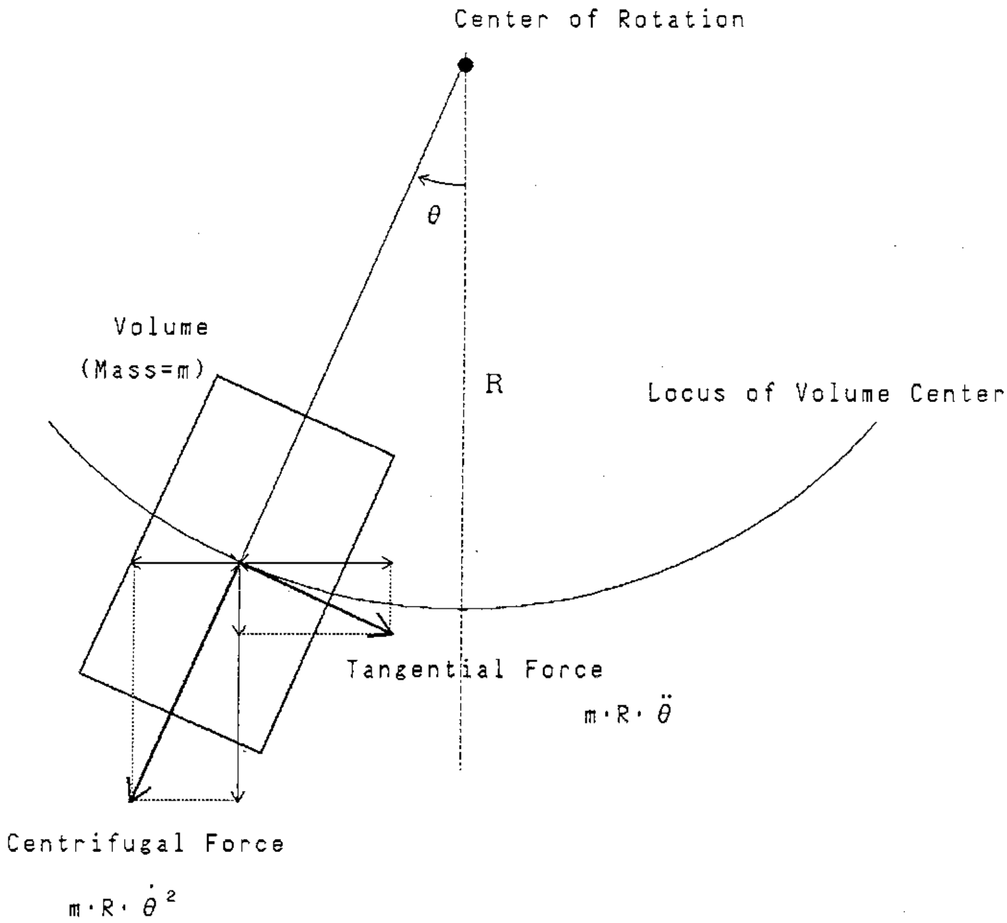

Fig. 2.4.1 Forces on the Fluid of Volume Under Rolling

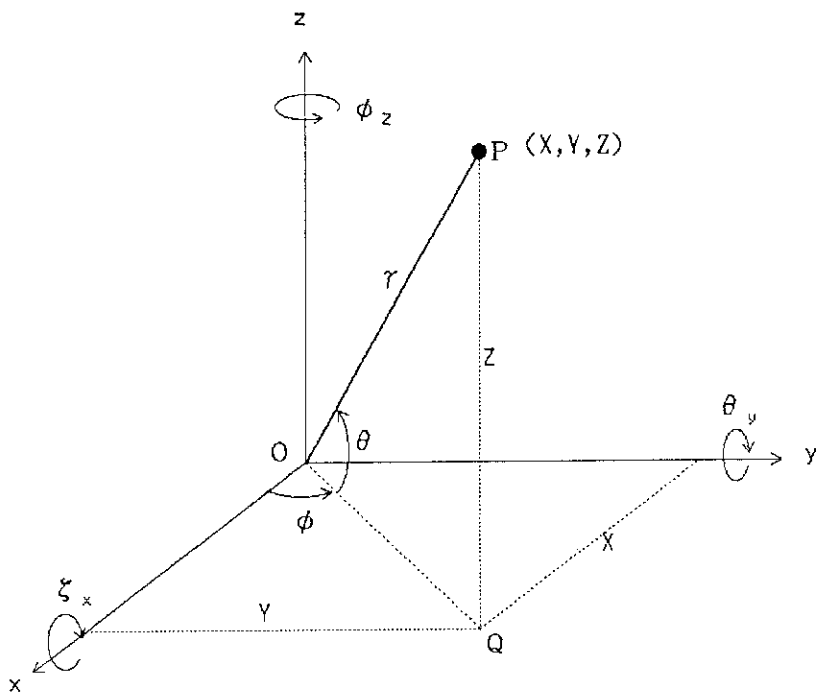

Fig. 2.5.1 Vector in Three-Dimensional Co-ordinates

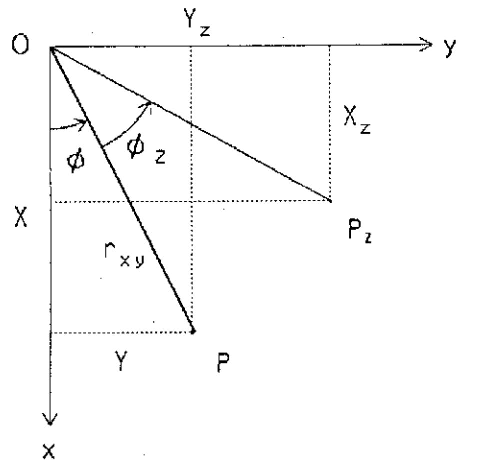

Fig. 2.5.2 Rotation of OP Around z-Axis

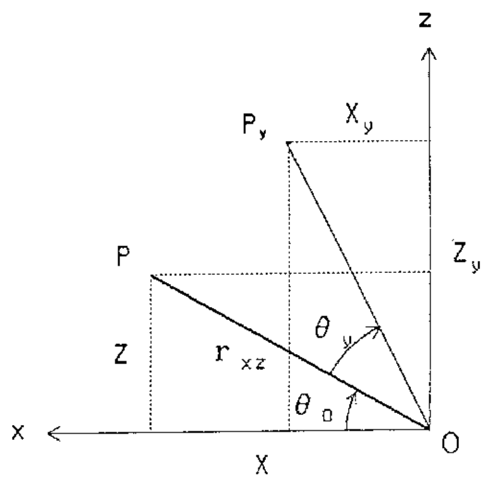

Fig. 2.5.3 Rotation of OP Around y-Axis

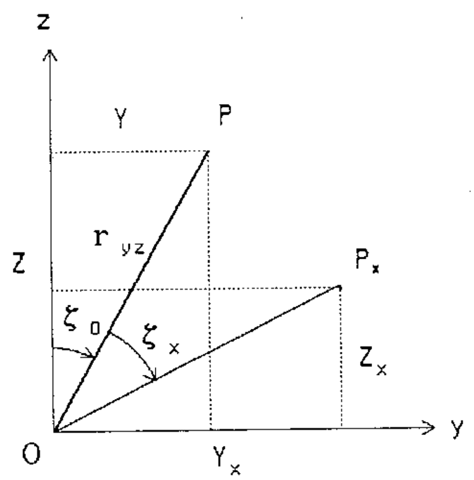

Fig. 2.5.4 Rotation of OP Around x-Axis

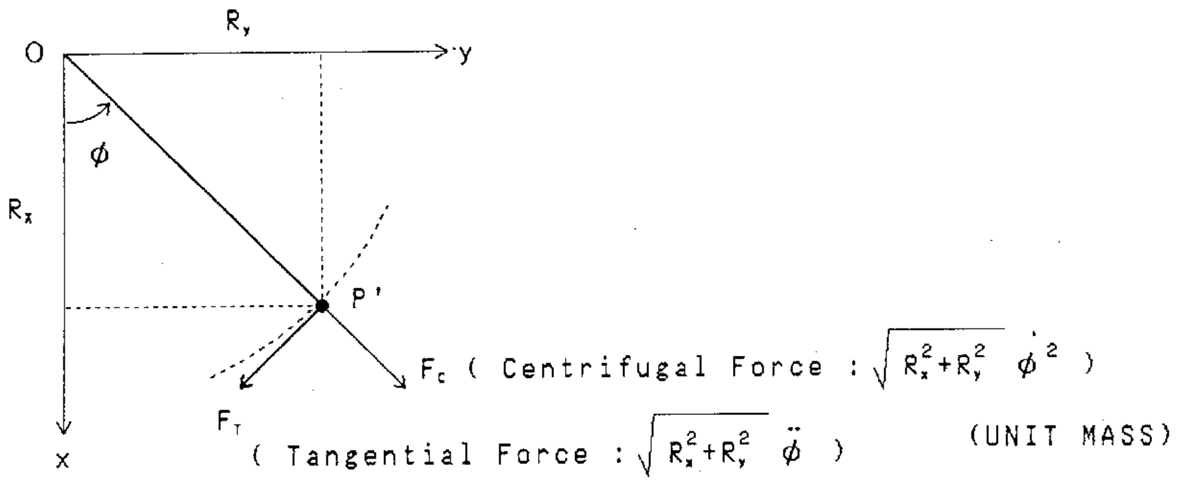

Fig. 2.5.5 Forces Under Rotation Around z-Axis

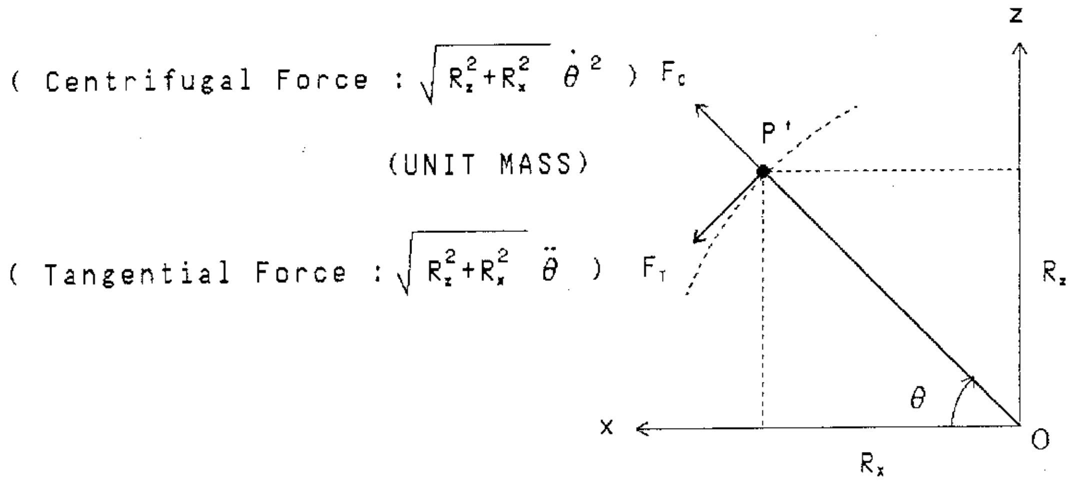

Fig. 2.5.6 Forces Under Rotation Around y-Axis

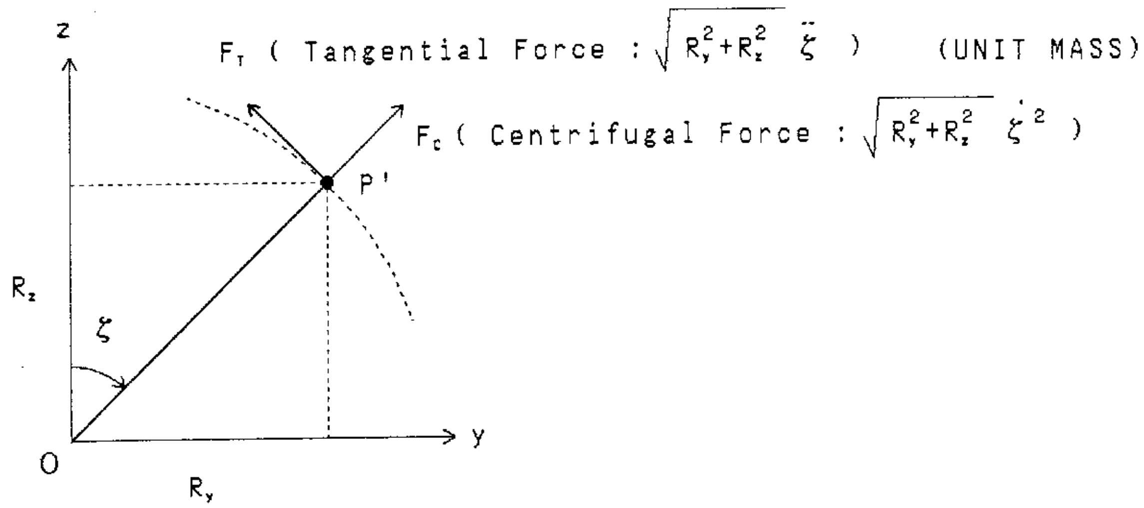

Fig. 2.5.7 Forces Under Rotation Around x-Axis

3. Verification of The RETRAN-02/GRAV with Experimental Data

The present code has been verified for the stability of numerical calculation, and then the physical validity of the calculated results has been checked using some simple idealized models and experimental data. The following three experimental analyses are introduced for code verification : the first is the single-phase natural circulation flow at inclined attitude ; the second is the single-phase and two-phase natural circulation flow under heaving ; and the third is the single-phase natural circulation flow during rolling motion.

3.1 Single-Phase Natural Circulation Experiment at Inclined Attitude

Experiments of the single phase natural circulation flow at inclined attitude in stationary state were conducted by Iyori et al[5]. Figure 3.1.1 shows the experimental rig which consists of two coolers, heater and connecting pipes. The experimental rig simulates a hybrid marine pressurized water cooled reactor. Total height of the rig is about three meters. Working fluid is fresh water. The operating pressure is atmospheric pressure (0.1 MPa) and core heater power is 60 kW. In the experiment, the steady natural circulation flows of two loops were measured with small propeller flowmeters installed in the hot and cold arm sections.

Figure 3.1.2 shows the experiments and analyses by RETRAN-02/GRAV together with the simple analysis by Iyori et al[5]. The analysis by RETRAN-02/GRAV was made as follows. The steady flow at zero inclination angle (that is, the upright state) was firstly set to equal the flow in the experiment by adjusting flow resistance factor. Then, the flow loop of the analytical model was inclined slowly to a certain angle. When the steady state of the analytical model at the certain inclination angle was established, the flows in each loop and the heater power were compared with those of the experiment.

The results show that the flow rate in the descending loop decreases, while the flow in the ascending loop increases with inclination angle. The reason is why the elevation difference between the heater and the cooler of the descending loop becomes smaller and one of the ascending loop becomes larger with inclination. As a result, the flow in the heater and the average of the both loop flow rates retain about 60% of the stationary state's flow rate even at 60 to 90 degrees of inclination.

The flow rate calculated by the RETRAN-02/GRAV analysis agrees fairly well with the experimental data, though the analytical model did not take account of the effect of the intrusion of the 'cold front' temperature into the descending legs and arm, which has a two-dimensional effect on driving force as described in reference[5].

3.2 Single- and Two-Phase Natural Circulation Flows Under Heaving

Heaving was simulated by Teshima and Yamaguchi[4] using a periodically and vertically moving experimental rig, which had been established on a carriage. Figure 3.2.1 shows the experimental rig. Table 3.2.1 shows the experimental conditions used for verification analysis. The rig with a single loop consists of the heater, the separator, the condenser and the connecting pipes (inner diameter = about 35 mm). The working fluid is water, the operating pressure is 0.1 MPa, and the heater power is 9.6kW.

Figure 3.2.2 shows the results of the single-phase experiments and analyses for the period of two oscillation cycles. In the analyses, the steady state was set so as to equal to the experiment, and the apparent gravitational acceleration of the experiment was used as an analytical boundary condition.

In the natural circulation, the apparent gravitational acceleration dominates the driving head of the flow. It is shown that the flow velocity in the single phase flow experiment varies with the center of the steady state velocity. The flow follows the acceleration change induced by heaving motion, with a few second time delay. The calculated velocity simulates well the experiment.

Figures 3.2.3 shows the results of the two-phase experiments and analyses for the period of two oscillation cycles. The flow at the heater inlet and the steam void fraction at the heater outlet were measured but not the heater outlet velocity. The heater inlet velocity changes together with the acceleration in the same manner as the case of the single phase experiment but accompanying a larger delay time. Since the heater power was held at a constant during the experiment, the change of void fraction at the heater outlet are seen to subject to the change of velocity at the heater inlet.

The analysis was performed with two different homogeneous models used in the RETRAN-02 for the two-phase thermal hydraulic dynamics : one was with the slip model of RETRAN-02 ; and the other was without slip model (homogeneous model). The velocity of the slip model shows smaller change than those of the homogeneous model and the experiment. The total amount of void fraction of the slip model approaches closer to the experiment than that of the homogeneous model. From the results of analyses, the features of two models are revealed : The general trends of the velocity and void fraction in both models are consistent with the experiments. Two models, however, differ in the heater outlet flow rate, though they were not measured and not presented here. The heater outlet flow rate by the slip model results in a wild oscillation, while that by the homogeneous model shows a smooth change following the heater inlet velocity. The wild oscillation seems to prove that the dynamic slip model of the present RETRAN-02 is not suitable to this experimental conditions and it should be improved.

3.3 Single-Phase Natural Circulation Flow Under Rolling

Experiments of the single phase natural circulation under the rolling condition were conducted by Murata et al[6]. The model rig with two flow loops consists of the heater, the coolers, and connecting pipes (see Fig. 3.3.1). The experimental rig simulates a hybrid marine pressurized water cooled reactor NSR-7[8]. The total height of rig is about 3m the same as one of the NSR-7. The working fluid is water, the operating pressure is atmospheric pressure (0.1 MPa), and the maximum heater power is 60 kW. The rolling angle is ± 22.5 degrees, and the rolling period is five to 20 seconds.

Figure 3.3.2 shows a typical example during one cycle of rotation by the heater power of 60 kW. The experimental results are shown by dotted line and the analysis by solid line. In the analysis, the steady flow in the stationary state was firstly obtained the same way as mentioned above by adjusting flow resistance. Then, the rolling motion is added to the the RETRAN-02/GRAV model rig. When the amplitude and period of flow oscillation become almost constant (after about 600 seconds), the analysed result is compared with the experimental results.

The flow rates in the heater W_{CORE} are almost constant during rotation. The flow rate during rotation of analysis is smaller than the experiment by about 100 kg/h (5 %). In the experiment, the flow rate during rotation increases with water temperature profile change in the heater and the cooler from the stationary state, and with decrease of flow resistance[6]. In the analysis, these effects due to the change of the temperature profile and the flow resistance are not taken an account of. These effects make the difference of the flow rate in the heater between the analysis and the experiment.

The flow rates of hot leg W_{BH} and of cold leg W_{BC} change with the rotation angle of θ. As the rotation angle is large to positive in the loops, the flow rates in the loops increase, vice versa. The variation of cold leg's flow rate is larger than that of hot leg's one because the tangential force becomes larger in proportion to the length from the center of rotation as shown in the Fig. 3.3.1.

The flow rates in the hot leg and the cold leg change with the delay time for the rolling angle. The delay time and the amplitude of the flow variation depend on rolling angular velocity. Figure 3.3.3 shows the delay time and the ratio of amplitude of flow variation in the loops to the heater flow rate ($\Delta W / W_{CORE}$) for the angular velocity, in comparison with the result of RETRAN-02/GRAV analysis. The delay time and the ratio of amplitude of flow variation are shown to increase with the angular velocity. The analysis result agrees quantitatively well with the experiment.

Forces causing the flow variation in rolling are considered to be water head driving head (F_1), the radial force (the centrifugal force, F_2) and the tangertial force (F_3). Effects of these forces on the flow variation are analytically studied using RETRAN-02/GRAV. Figure 3.3.4 the shows the change of forces F1 only, the change of F1 and F2, and the change of F1, F2 and F3 for the change of hot leg flow rate in one cycle of rolling. This reveals that the tangential force dominates the flow change of the hot leg (or cold leg) in the rolling motion. As the result, the response of WCORE, WBH, and WBC to the rotation from RETRAN-02/GRAV calculation are well agreed with the experimental flow rate.

It is concluded that the physical validity of analyses results obtained from RETRAN-02/GRAV calculation has been verified.

Table 3.2.1 Experimental Conditions of the Natural Circulation Under Heaving Motion

Paramenters	Single-Phase Flow Experiment(4)	Two-Phase Flow Experiment(4)
1. Fluid Material	Water	Water
2. Pressure (MPa)	ca. 0.1	ca. 0.9
3. Heater Inlet Subcooled Temperature (℃)	ca. 75	22.5
4. Heater Power (kW)	9.6	12.5
5. Apparent Gravity Oscillation		
Max.Magnitude (g)	ca. 0.2	ca. 0.3
Period (second)	ca. 4.0	ca. 4.0

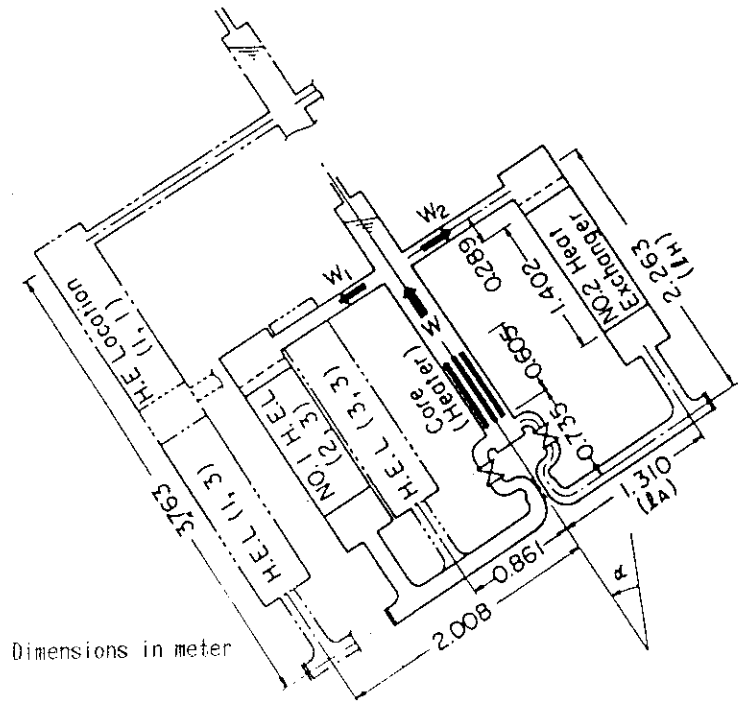

Fig. 3.1.1 Experimental Rig for Natural Circulation at Inclined Attitude with Angle α[5]

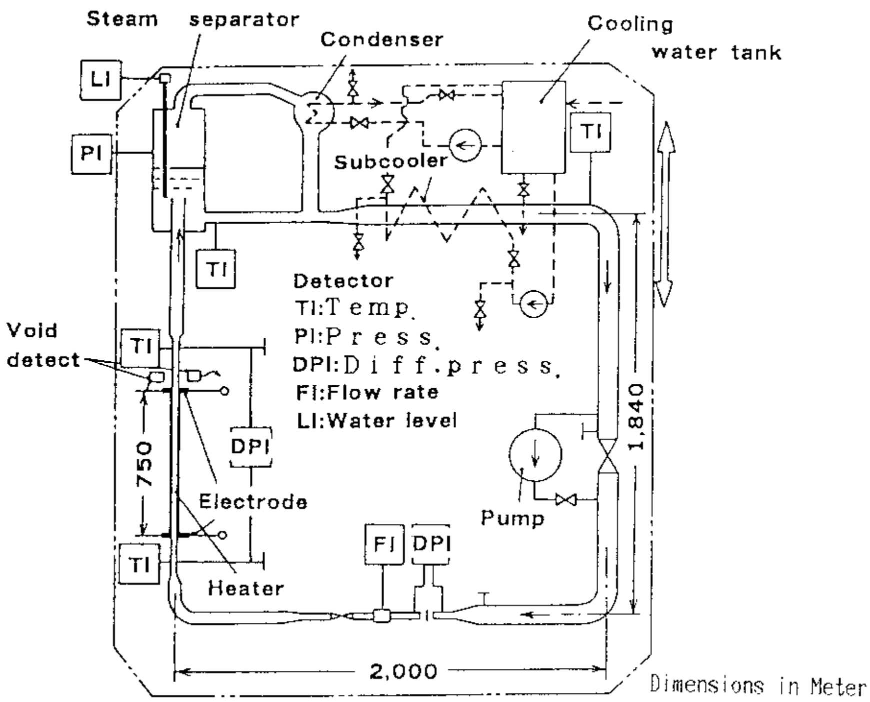

Fig. 3.2.1 Experimental Rig for Natural Circulation Under Heaving

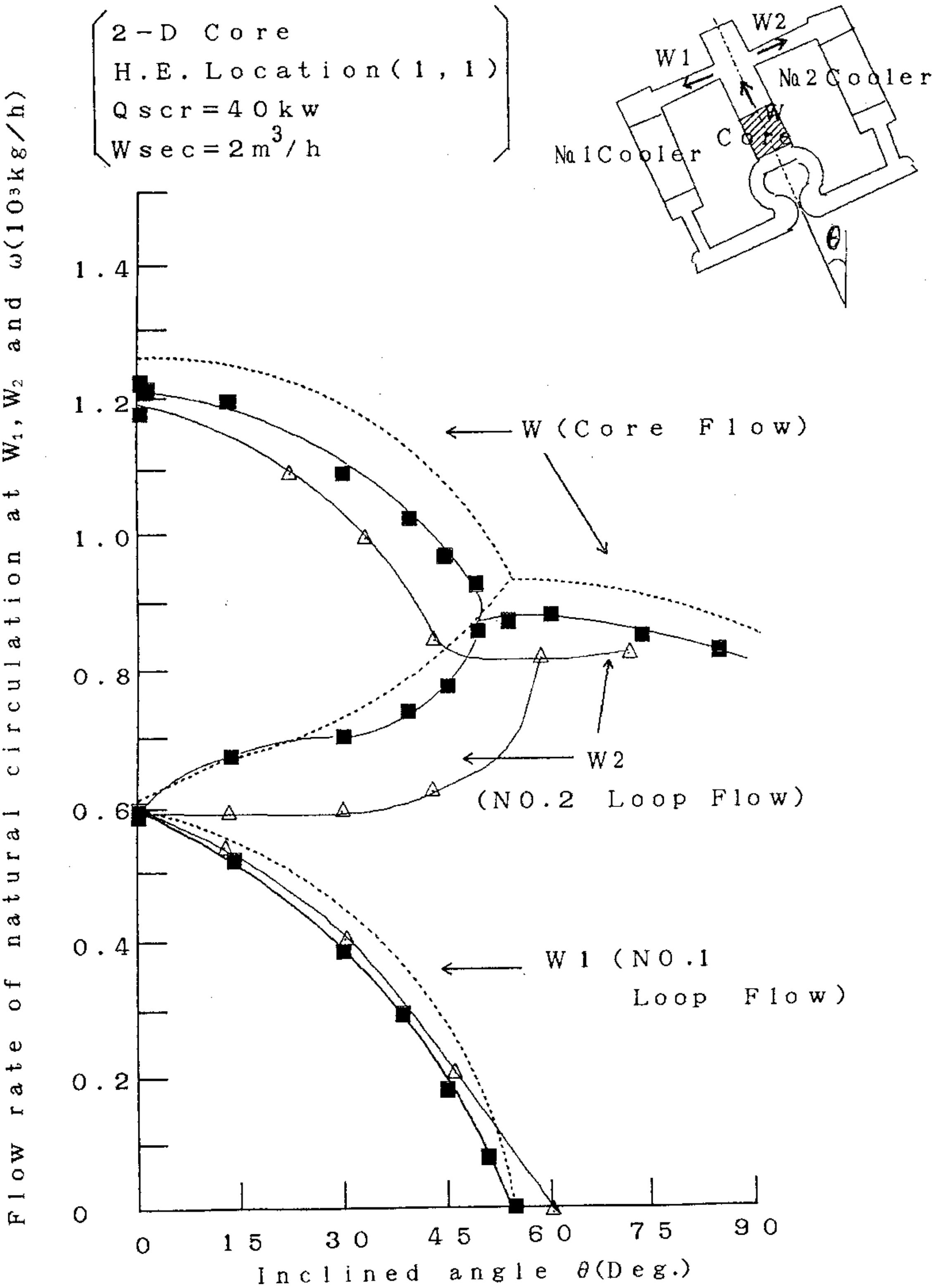

Fig. 3.1.2 Comparison Between RETRAN Analysis and Experiment for Natural Circulation at Inclined Attitude with Angle θ

—■— Experiment
---- Iyori et al's calculation
—△— RETRAN-02/GRAV

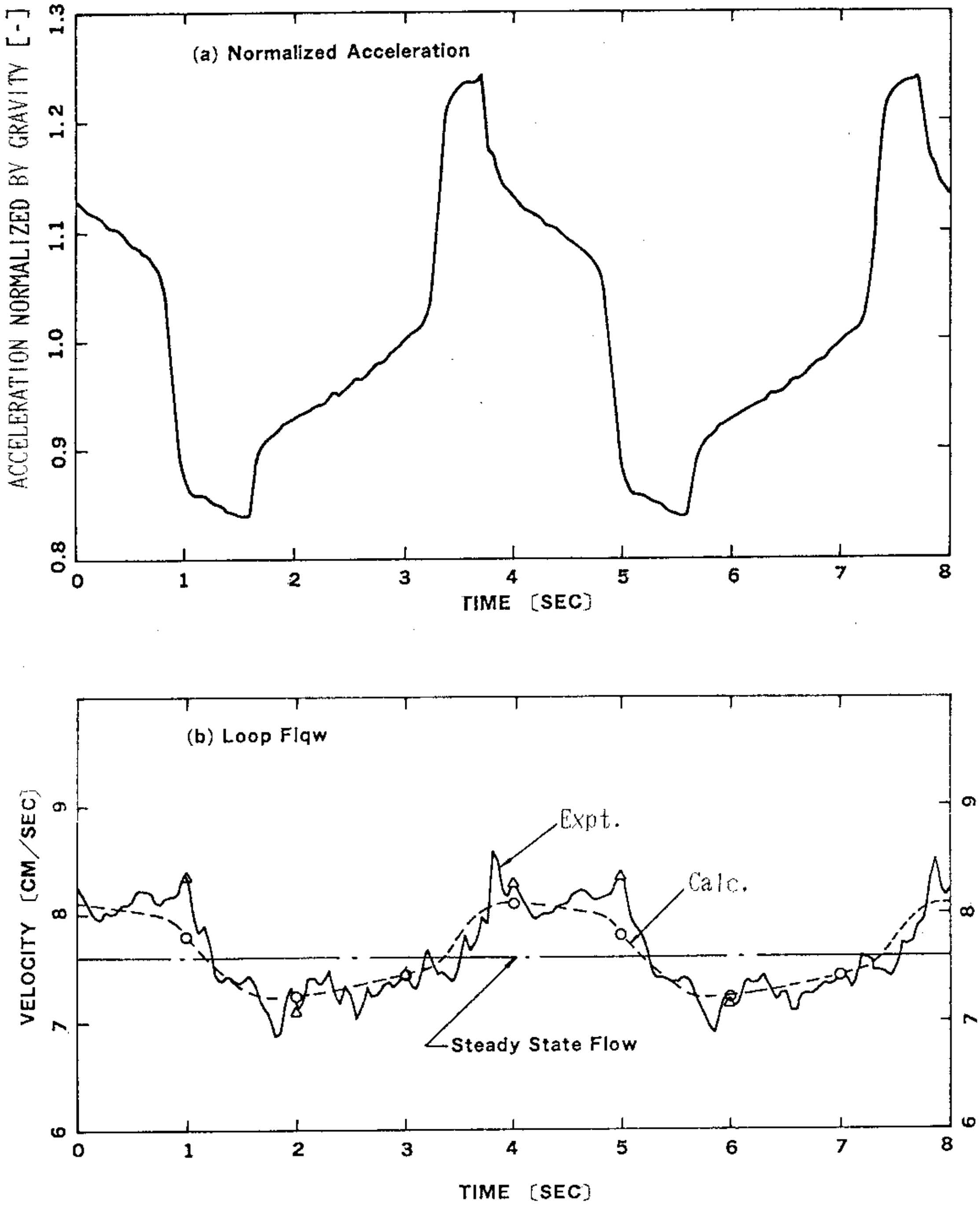

Fig. 3.2.2 Comparison of Between Analysis and Experiment for Single-Phase Natural Circulation Under Heaving

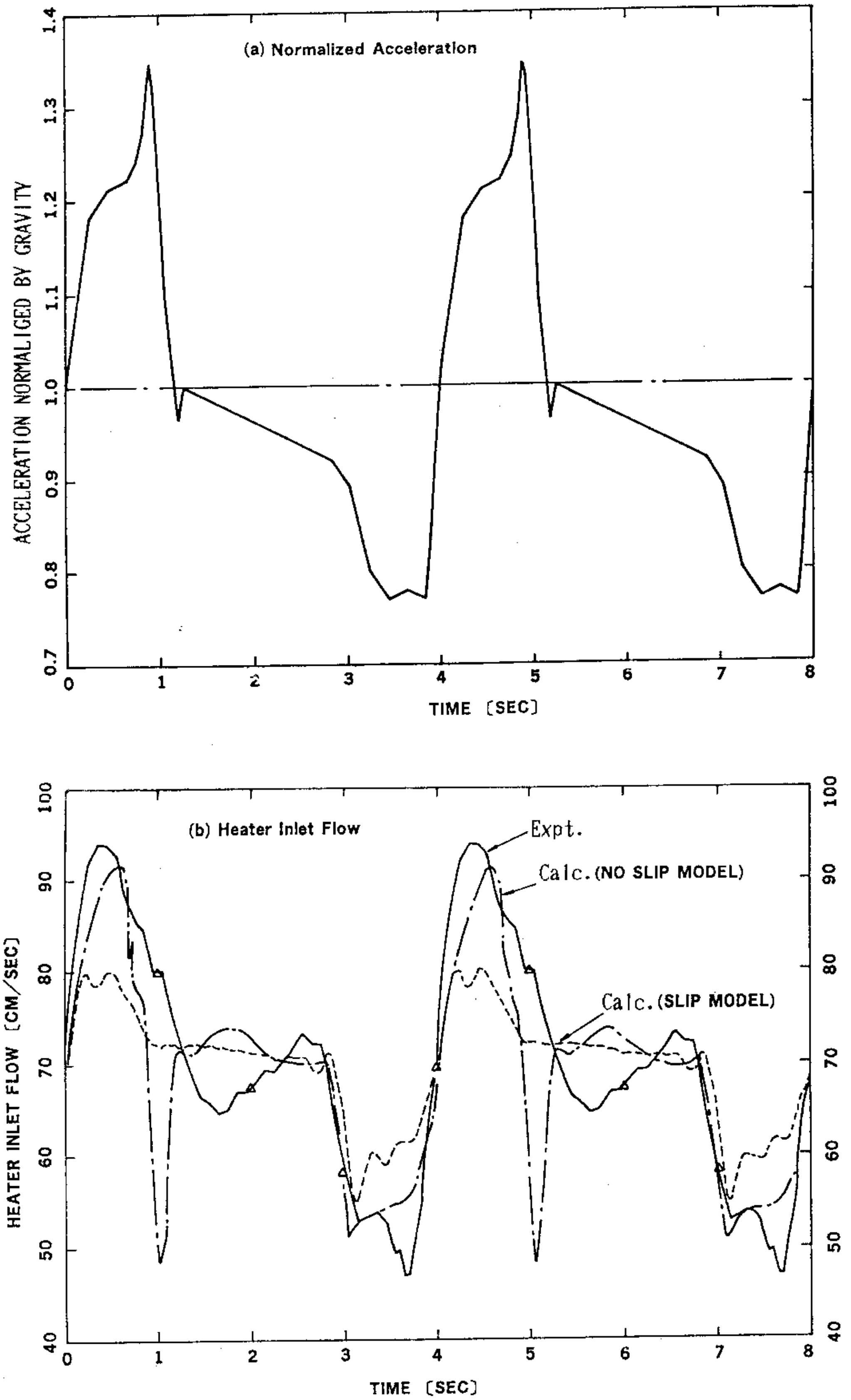

Fig. 3.2.3 Comparison Between RETRAN Analysis and Experiment for Two-Phase Natural Circulation Under Heaving

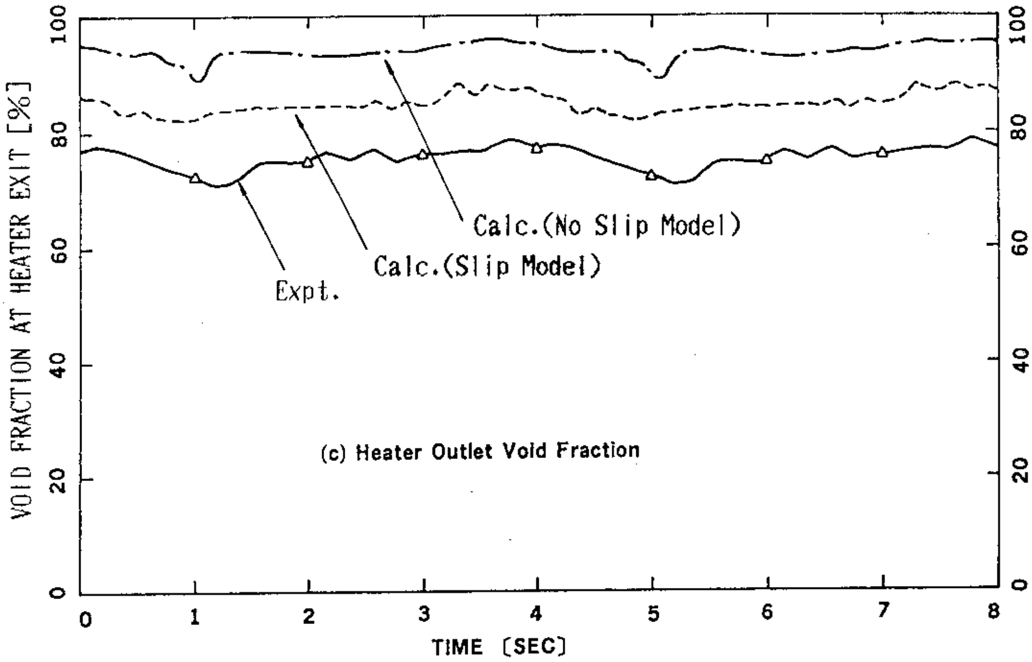

Fig. 3.2.3 (Continued)

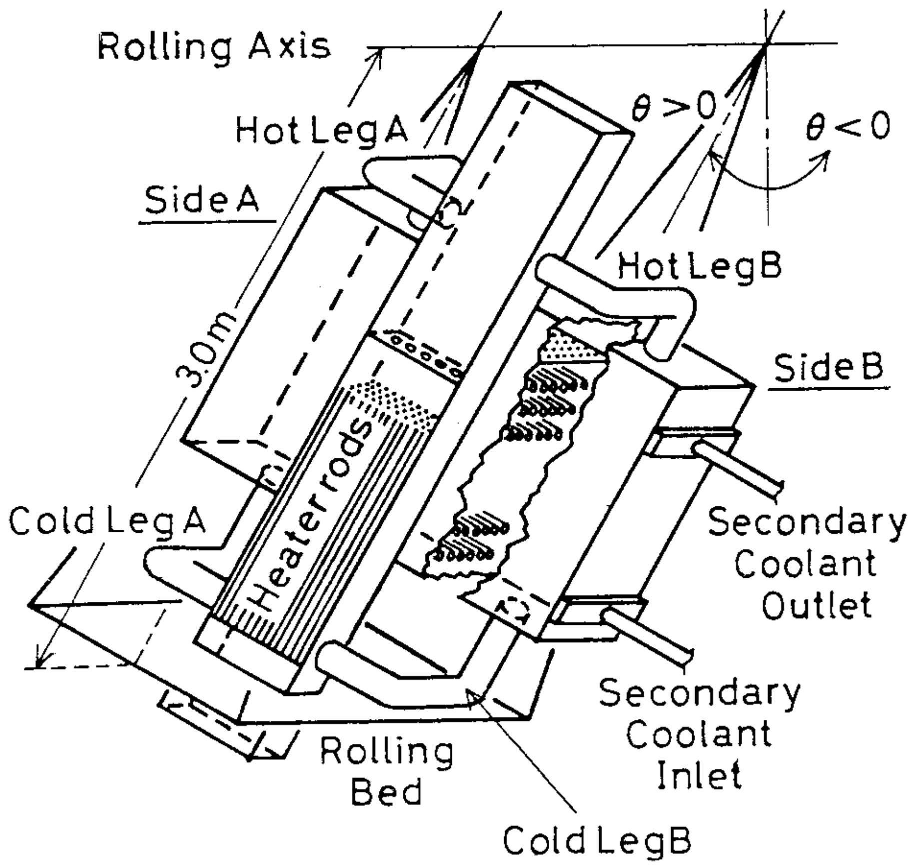

Fig. 3.3.1 Experimental Rig for Natural Circulation Under Rolling[5)]

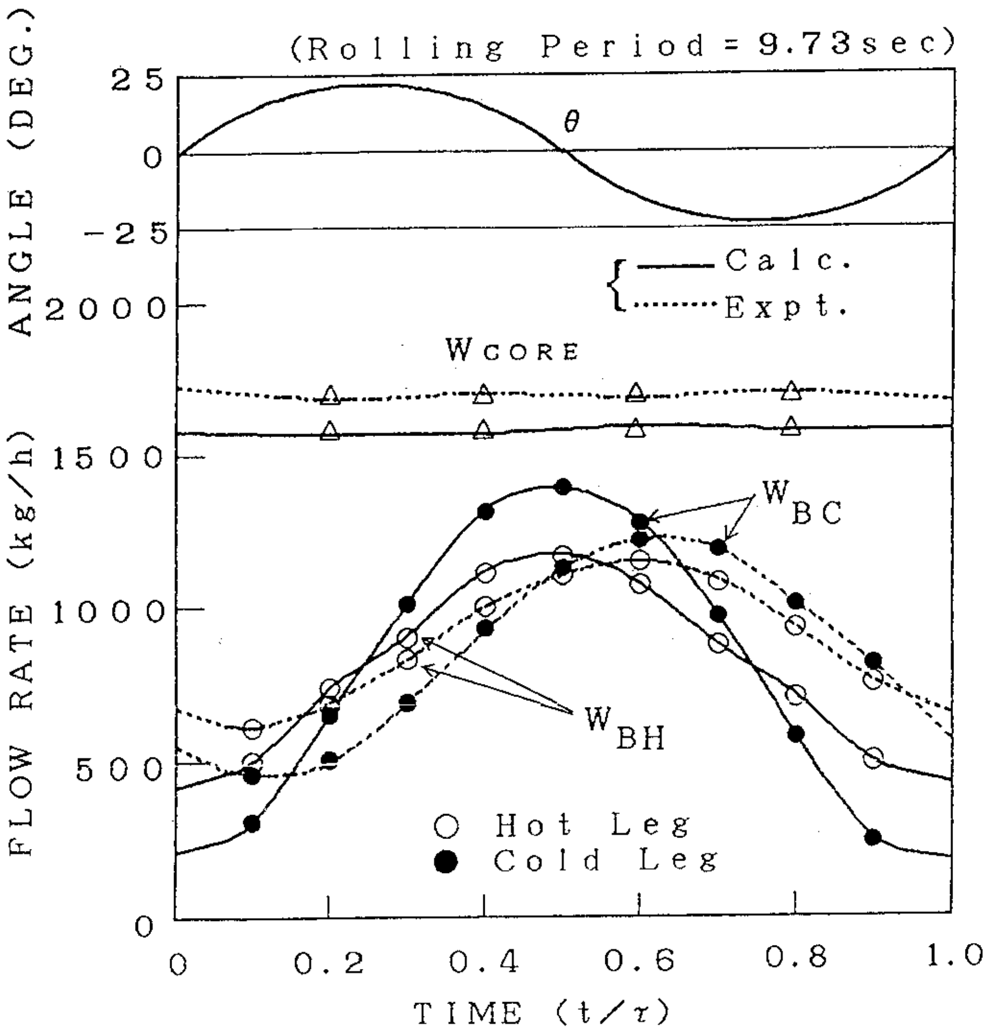

Fig. 3.3.2 Comparison Between RETRAN Analysis and Experiment for Natural Circulation Under Rolling
(W_{CORE}: Core Flow Rate, W_{BH}: Hot Leg Flow Rate,
W_{BC} : Cold Leg Flow Rate.)

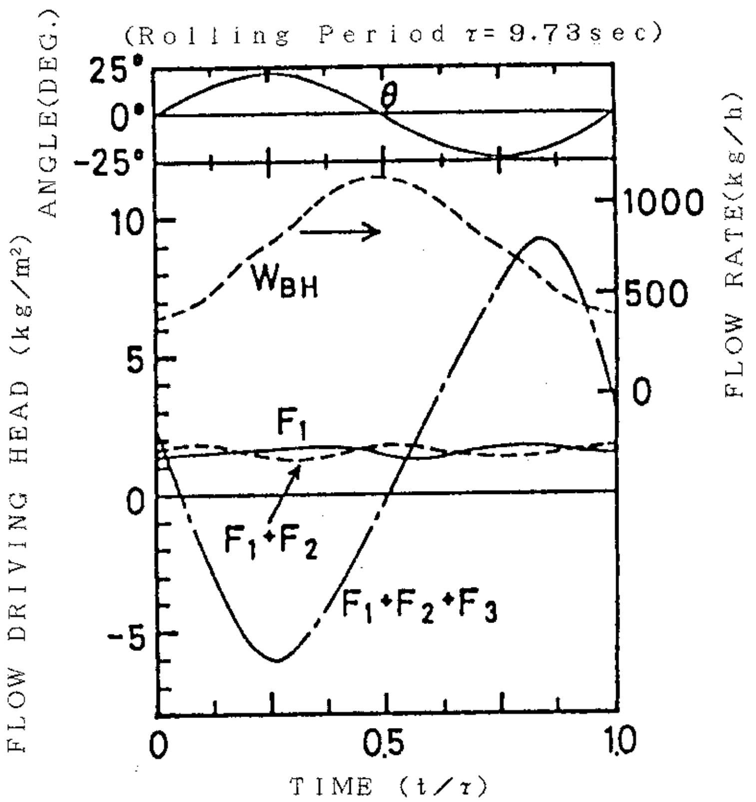

Fig. 3.3.3 Amplitude for Flow Variation and Delay Time of Flow Rate to Rolling Angle

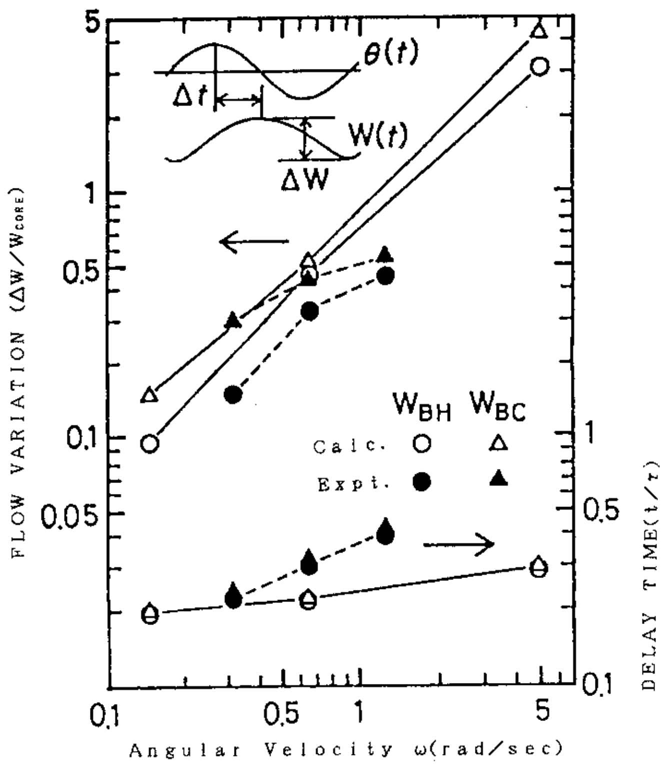

Fig. 3.3.4 Change of Forces in Case of F_1, $F_1 + F_2$ and $F_1 + F_2 + F_3$ Under Rolling
(F_1: Water Head, F_2: Head of Radial Force
F_3: Head of Tangential Force)

4. Application of the RETRAN-02/GRAV to Predicting Analyses of Thermal Hydraulic Behavior of N.S. Mutsu Reactor in Experimental Voyages

4.1 Description of N.S. Mutsu Reactor and Analysis Model

The reactor of nuclear-powered ship N.S. Mutsu is a two-looped PWR with a rated core power of 36 MW (thermal). Figure 4.1.1 shows the arrangement of the reactor coolant system (RCS). The RCS consists of the reactor vessel, two coolant loops with steam generators (SGs), two main coolant pumps (MCPs) and a pressurizer. The main coolant pipes are U-shaped to allow the thermal expansion. The specific features of the reactor design in comparison with those of the land based PWR is presented in Table 4.1.1. The detailed description is given in reference[9]. The Mutsu reactor is a compact one comparing the land based PWR.

The thermal hydraulic performance in the marine reactor system is characterized by the frequent heavy load changes caused by maneuvering a main steam turbine for ship propulsion and by ship motion. Table 4.1.2 shows the comparison of design-base conditions between three marine nuclear ships of Mutsu[10], Otto Hahn[11], and Savannah[12]. These design conditions were determined by taking account of maneuvering in ordinary marine cargo ships, and those of land based PWRs.

On ship motion, Table 4.1.3 presents the design-base conditions of Mutsu, which were determined based on the statistics of the sea weather data. Although these severe conditions will rarely encountered in the experimental voyages, the reactor control system is designed to follow heavy load conditions and the ship motion with operation of an automatic control system.

The automatic control system consists of mainly the reactor power control system, the SG feed water control system, the pressurizer pressure control system and the pressurizer water level control system. The average temperature in the reactor is controlled to be a constant by reactor power control system (called as Tav-constant control method). In general, the reactor power in marine PWR is controlled not by chemical shim but by control rods since the chemical shim will be not useful in case of ship sinking.

The SG water level is controlled by a feed water control system with feed water pumps and feed water control valves. One of feed water pump is required to provide a pump outlet pressure depending the SG pressure since the SG pressure changes with the steam flow rate. The cascade control method is adopted for feed water pump controller : the deviation signal of pressure difference through the feed valve is controlled to become the desired value of the pump outlet pressure controller (see Fig. 4.1.2).

The feed water valve is actuated by a controller having three signals of detected water level, feed water flow rate, and steam flow rate. It is noticed that the detected water level contains the effect of the apparent gravity, since the water level gauge is of a type of measuring of pressure difference of the water heads.

The detected water level (gauge level: h_g) is expressed as,

$$hg=\frac{(1-\beta)(\rho_a-\rho_g)H+\beta(\rho_l-\rho g)h_{rel}}{(\rho_l-\rho_g)} \quad (4.1)$$

where, β is the acceleration normalized by the gravity, ρ_a is the water density of a standard leg, ρ_g is the density of SG steam, ρ_l is the density of SG saturated water, h_{rel} is the SG water level (actual water level), and H is total gauge length. From this relationship, for the apparent gravity of, for example, 1.6g, the gauge level becomes lower about 20% level from the nominal water level.

Figure 4.1.3 shows the nodalization scheme used in the RETRAN-02/GRAV model. The model is composed of 42 volumes, 61 junctions, and 11 heat conductors. Figure 4.1.4 shows RETRAN-02/GRAV computational model of SG feed water control system containing the feed water pump and feed water control valve. Besides the SG water control system, the automatic control system is modelled for the reactor power control system, the pressurizer pressure control system and the pressurizer water level control system.

4.2 Effects of Inclination on N.S. Mutsu Reactor

4.2.1 Steady State Operation at the Normal Power

Figure 4.2.1 shows the analysed result of the reactor system response to the ship inclination during the normal power operation (90% of the full power). Inclination is given instantaneously to 30 degrees at time zero and then the attitude is held. Inclination of 30 degrees is the design-base value and only for to study analytically the behavior of the reactor plant.

The water level and the pressure of SG secondary side parameters oscillate due to the disturbance of inclination, and the oscillation remains for a long period. This causes the cold leg temperature to oscillate. But, the hot leg temperature is almost constant. The reactor power varies due to the feed back effect of moderator temperature coefficient in the early period after completion of inclination, but after 60 seconds it becomes negligibly small. After about 100 seconds, the reactor power returns to the initial steady state together with variations of the parameters in the SG secondary side. Decay of the oscillation of the SG water level or the SG pressure take a long time.

From these result, it can lead that the effect of stationary inclination on the reactor system at the normal operation is negligibly small.

4.2.2 Natural Circulation

Natural circulation at inclination attitude of Mutsu is also studied analytically. Figure 4.2.2 shows the flow rates in the core, the cold leg and the hot leg after main coolant pumps tripped at inclination of 15 and 30 degrees. The reactor is tripped from the normal power operation (90% of the rated power) at 30 seconds, and then the main coolant pumps are tripped at 75 seconds.

The flow rate of descending loop (No.1 loop) decreases to almost zero in case of 30 degrees inclination. On the contrary, the flow rate of ascending loop (No.2 loop) increases. The core flow rate at 900 seconds is about 1.7% of the rated flow with pump running. The fluid temperatures in the core, the cold leg and the hot leg change according to change of the flow rates and the core power : the water temperature difference between the hot leg and the cold leg becomes almost constant while these temperatures decrease with core power decreasing. Quasi-steady state natural circulation in the ascending loop is established after about 600 seconds.

In the case of 15 decrees inclination, on the other hand, the quasi-steady natural circulation is attained earlier. The flow rate in the descending loop is about 60 % of the flow rate in the ascending loop, and the core flow rate is 1.3 times larger than that in the case of 30 degrees inclination.

The general trend of natural circulation at inclination attitude of Mutsu is consistent with the experimental results by Iyori et al[5]: the flow rate in a descending loop decrease and the flow in this loop stagnate at a certain angle of inclination (i.e. one loop flow). From these analysis results, the natural circulation of Mutsu with two loops can be established at inclination angle of at least below 15 degrees, and even at 30 degrees the core heat is able to be removed steadily only by one loop operation .

4 .3 Effects of Heaving on N.S. Mutsu Reactor

4.3.1 Steady State Operation at the Rated Powers

Since the SG secondary side has water level and its flow is the two-phase natural circulation, the water level and re-circulation flow of the SG will be mostly affected by the heaving. Figures 4.3.1(1),(2) and (3) shows the response of the SG water level and the re-circulation flow to the oscillation period of four seconds of the apparent gravity the heaving during the rated power operation (100% power). The apparent gravitational acceleration is given as sinusoidal oscillation of which amplitude is 0.6g (the design value) and the oscillation period is from 4 to 30 seconds. In the figure, the water level obtained from a simple design analysis assuming the constant feed water and the constant heat transfer rate from the primary side is shown as dotted line.

The analyses show that as the apparent gravity acceleration becomes larger, the water level becomes lower ; the longer oscillation period of acceleration results in the larger variation in both of the water level and the re-circulation flow rate. The magnitude of variation in the water level obtained by RETRAN-02/GRAV calculation is by almost two times larger than that of the design analysis. But, the general response of the water level to the acceleration change is qualitatively consistent in those analyses.

Figure 4.3.2 shows the variation of the SG water level (the actual water level) and the detected water level (the wide ranged gauge water level) for the magnitude of acceleration for the period of 15 seconds. The variations becomes greater with the magnitude of acceleration. The variation of wide ranged gauge water level is smaller than that of the SG water level. This is the reason why the gauges have the low pass filtering (τ =10 seconds) of input signal of the water levels from the differential pressure transmitter. The results shows that the wide ranged gauge water level does not reach the high alarm level and the reactor trip level (the reactor scram level) even for the oscillation magnitude of 0.6g.

The RETRAN-02/GRAV analysis also shows that the effect of heaving on the primary side parameters such as reactor power and primary loop water temperature are negligibly small at steady state operation with a constant steam flow rate of SG.

4.3.2 Turbine Trip

As one of typical heavy load transient, the turbine trip under heaving motion is analysed. The turbine trip test of the power-up test without the ship motion is analysed for an analytical base.

Figures 4.3.3(1), (2), (3) and (4) show the results of the test of the turbine trip and the RETRAN-02/GRAV analysis without ship motion. A transient began with complete loss of the turbine steam flow from 100% of the full-power operation. The total steam flow decreased from about 100% to about 25% in a few seconds. With decreasing total steam flow, the reactor power decreased in early

period with insertion of the control rod due to the mismatch signal of power-load, and the power decreased in later period due to a negative reactivity insertion given by temperature rise of the coolant. The changes of the average temperature of the primary coolant were by about five degrees (℃) and the pressurizer pressure by about
2 kg/cm^2 in the transient.

The SG pressure increased to about 55 kg/cm^2G due to load decrease, but the pressure was under the main steam dump operation pressure (62.5 kg/cm^2G). The SG gauge water level (the narrow ranged water level) shrinked by about 13% from the initial level owing to pressurization in the SG, afterward the water level recovered to the normal operating one. The reactor attained the steady state after about 20 minutes from the main turbine trip. The analysis results shows a good agreement with the test. Details of the RETRAN-02/GRAV analyses of power-up test will be discussed in other report.

Figures 4.3.4(1),(2),(3),(4) and (5) show the analysed result of transient with heaving and without heaving as comparison. Heaving of sinusoidal oscillation of magnitude 0.6g and period 15 seconds adds to the transient. The steam flows are almost same in both cases, while the SG feed water flow in the case of heaving oscillates due to SG water level oscillation. The SG gauge water level oscillates in heaving by about 25 cm span at the core power of 100%, and by about 6 cm span at the power of 25%. The amplitude of water level oscillation becomes larger with increase of reactor power since circulation flow increases with reactor power. The SG pressure and the SG re-circulation flow show small oscillation due to effect of acceleration change. The reactor power, the primary loop average temperature, and the pressurizer pressure of the primary side parameters are not influenced much by heaving as shown in Fig. 4.3.4.

The results show that the Mutsu reactor responds to the load change due to heaving even without operation of any relief valve and the reactor trip.

4.4 Effects of Rolling on N.S. Mutsu Reactor

4.4.1 Steady State Operation at the Normal Power

Rolling also affects the behavior of SG secondary side. Figures 4.4.1(1), (2)and (3) show the analysis of response of the SG water level to rolling during the normal power operation. The rolling period is 15 seconds which equals the rolling period peculiar to Mutsu, and the rolling angles are 5, 10, and 30 degrees.

It is noted that the SG water levels oscillate with a half period of rolling. The reason is that the driving force due to the water head term in the SG oscillates with a half period of rolling and the water head term dominates the oscillation rather than the tangential force or the centrifugal force which vary with the same period as rolling one. Therefore, the oscillation amplitude of the SG water level becomes larger with rolling angle rather than rolling period. The analysis shows the SG water level varies nearly in the range from 10 cm to 15 cm. These variation corresponds to those with heaving of 0.1g amplitude and 15 seconds period.

4.4.2 Natural Circulation

Analysis of natural circulation under rolling is performed to study the effect of rolling on the core cooling by natural circulation. Figure 4.4.2 shows the flow rates in the core, the hot leg and the cold leg after the main coolant pumps trip under rolling with the period of 15 seconds and the angle of 30 degrees. The reactor is tripped from the normal power operation at 30 seconds, and the main coolant pumps are tripped at 75 seconds.

The loop flow rates oscillate with the same period of the rolling period. The core flow rate also oscillates with a smaller amplitude than the loop flows. The oscillation period of the core flow rate is a half the rolling period because of two loop flow's oscillation. The general behavior is consistent with the experimental results by Murata et al6).

Water temperatures in the cold legs in natural circulation are nearly constant by assuming a constant pressure for both of the two SGs through transient. Water temperature in the hot legs decrease slowly with decrease of the core decay heat. It is clear that there is not the effect of rolling on the primary loop water temperature and that the core can be cooled down by natural circulation under the rolling with increased steam flow rate.

4.5 Effects of Ship Motions on N.S. Mutsu Reactor in the Experimental Voyage

In general, marine ships must travel through various sea weathers, not only an ordinary sea but also sometime a rough sea through her ship's life. Main purpose of Mutsu experimental voyage is to obtain the data about the effect of sea conditions such as swell or wind wave on reactor performance through ship motion in various sea weathers. To clarify the effect of these sea conditions, the sea zones in the experimental voyage are divided into the following four zones : ① a calm sea zone, ② an ordinal sea zone, ③ a rough sea zone, and ④ a tropical sea zone. Performances of the reactor system in these sea zones will be compared to clarify the effect of ship motion on the reactor.

The sea zones should be determined efficiently because of a limited term of the voyage. It is efficient that in planning of her voyage schedule, the sea zones of ①, ②, ③ are defined from the viewpoint of the magnitude of ship motion and the magnitude of swell or wind wave inducing the effect of ship motion on the reactor, aparting from a common definition in the shipping world : the rough sea gives a certain clear effect of ship motion on the reactor ; the calm sea does negligibly small effect ; and the ordinal sea does a larger effect than that on the calm sea but smaller one than that on the rough sea.

The results of RETRAN-02/GRAV analysis have been used to estimate the effect of ship motion on the reactor in deciding sea zones. The magnitude of ship motion by swell or sea wave has been estimated by another analyses of a ship dynamics.

In this section, the magnitude of ship motion on Mutsu reactor through the experimental voyage is discussed. First, the critical values of variation of the acceleration and the flow rate variations by ship motion which give a certain clear effect on the process variables of reactor plant are evaluated using the analytical results. And then, applicable and realistic sea conditions are recommended to the four sea zones.

The process variables to be evaluated were chosen as SG water level, SG feed water flow rate, steam flow rate from the SG, and position of control rods. The other process variables such as the pressurizer's pressure are presumably affected smaller than those ones. The SG water level is considered to be affected mostly by the acceleration change due to heaving or rolling. The SG feed water flow rate is affected indirectly through the acceleration by operation of feed water control system. The steam flow rate varies by the load change of a propulsion turbine due to swell or sea wind in use of the turbine revolution feed back control system. The position of control rods also move indirectly through variation of load change by operation of the reactor control system owing to steam flow variation. The critical values giving a certain clear effect on the process variables of reactor plant are evaluated as follows.

(1) The SG water level

The critical value for the SG water level variation owing to acceleration is taken as 30 mm of the actual water level which equal one percent of wide ranged gauge water level span (0.01x full span (3000 mm) = 30 mm). These acceleration are obtained from the analysis for the steady state operation at the rated power with heaving in the same way as described in sec. 4.3.1.

Figure 4.5.1 shows the relationship between the magnitude and the period of sinusoidal oscillations of acceleration which induce one percent (30 mm) variation of the actual SG water level. The variation of 30 mm of the SG acutual water level equals almost that of one percent of the narrow ranged gauge water level, since the variation of input signal from the transmitter is mitigated by filtering the signal.

(2) The SG feed water flow rate

The critical value for variation of the SG feed water flow rate which stem from the SG water level changing due to the acceleration is taken as two percent of the rated flow rate by taking account of measuring errors. These acceleration are obtained from the analysis for the steady state operation at the rated power with the heaving in the same way as SG water level.

Table 4.5.1 shows the magnitude of acceleration which induces two percent variation of the SG feed water flow rate for the period of acceleration. Because of low pass filtering of the signal of water level and delay times in the feed water control system, larger acceleration is necessary for SG feed water flow variation than SG water level variation.

(3) The steam flow rate from the SG

The critical value for the variation of steam flow rate from the SG due to change of the propulsion turbine load is taken as five percent of the rated steam flow rate by taking accounts of fluctuation of steam flow, change of base load and measuring errors. The conditions of swell or sea wind causing these steam flow change should be obtained from the other analysis about the turbine load variation by swell or sea wind through ship motions.

(4) The position of control rod

When a rate of the steam flow change due to variation of the propulsion turbine load is large, the control rod are withdrawn or inserted. The critical value of the steam flow rate change is taken as the variation of which speed makes a temperature difference signal of 0.6 ℃ necessary for the control rod moving in the reactor control system. Table 4.5.2 shows the magnitude and the period of sinusoidal steam flow change which move the control rod. The conditions of swell or sea wind causing these steam flow change should be also obtained from other analysis.

The analyses of ship dynamics show the relationship between sea wind or swell and ship motion (the results is not yet published). For example, a head wave with wave height of 8 m (the period of 8 seconds) is necessary for the acceleration of 0.2g (the period of 8 seconds), and 6 m (12 seconds) is necessary for the acceleration of 0.11g (12 seconds) . The wave height over 8m occurs rarely in statistic at ordinary sea even on the north pacific ocean. These two facts should be taken into account in deciding applicable and realistic sea conditions. Moreover, from the fact that SG water level is affected mostly by acceleration, the critical value for the SG water level is recommended as one of parameters in decision of the sea zones in the experimental voyage, as follows.

It is recommended that the rough sea is a sea zone where the acceleration by ship motions is greater than that which varies the SG actual water level by 30 mm *) ; the calm sea is a sea zone where the acceleration by ship motions is smaller than that which varies the SG actual water level by 15 mm**), since the calm sea should give negligibly small effect ; the normal sea is a sea zone where the acceleration by the ship motion ranges from that of the calm sea to that of the rough sea. Figure 4.5.2 shows the magnitude and the period of the acceleration due to ship motion recommended to deciding the sea zones in the Mutsu experimental voyage. The heights and the periods of swell or wind wave which are equivalent to those acceleration will be evaluated by analyses of ship dynamics in a near future.

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*) It equals the variation of one percents of the narrow ranged water level and also equals four percents of the narrow ranged water level signal in front of filtering.

**) It equals the variation of 0.5 percent of the narrow ranged water level and also equals two percents of the narrow ranged water level signal in front of filtering.

Table 4.1.1 Specific Features of Mutsu Reactor Design in Comparison with Land-Based PWRs[9)]

Design Parameter	Mutsu Reactor	Land-based PWRs
1. Reactor Power [MW(thermal)]	36	1650 (Ikata-1,2)
2. Average LHGR (kW/m)	9.65	17.5 (RESAR-41)
3. Reactor Operating Pressure (MPa)	10.9	15.6 (RESAR-41)
4. Average Coolant Temperature(°C)	278	305.5 (Ikata-1,2)
5. Subcooled Temperature of the Primary Coolant With Respect to Reactor Power (℃/MW)	32	14 (RESAR-41)
6. Specific Inventory of the Primary Coolant With Respect to Reactor Power (℃/MW)	280	75 (Ikata-1,2) 68 (Takahama-3,4)
7. Steam Generator Pressure at 100% Power (MPa)	4.02	5.78 (Ikata-1,2)
Steam Flow Rate (kg/h/unit)	3.06×10^4	1.62×10^6 (Ikata-1,2)

Note: Ikata-1 and -2 are two-looped PWRs.
Takahama-3 and -4 are three-looped PWRs.

Table 4.1.2 Comparison of Design Base Conditions Between Three Marine Nuclear Ships of Mutsu, Otto Hahn and Savannah

	Mutsu[(10)]	Otto Hahn[(11)]	Savannah[(12)]
Load Increase (steam flow %)	18% to 90% in 30 seconds	10% to 100% in 90 sec.	20% to 80% in 10 sec.
Load Decrease (steam flow %)	100% to 18% in one second	100% to 10% in one sec.	100% to 20% in 3 sec.
Load Change (steam flow %)	1) Ahead to Astern: 100% to 18% in 5 sec., 50 sec. holding, and 18% to 80% in 30 sec. 2) Astern to Ahead: 80% to 18% in 5 sec., 50 sec. holding and 18% to 100% in 30 sec.	———	———
Remarks	———	In emergency, maximum increase rate is 4% / sec.	———

Table 4.1.3 Design-Base Conditions of Mutsu for Ship Motions

	*)
1. Vertical Accerelation Force due to Heaving	$g = g_0(1 \pm 0.6)$; 4 to 15 cpm
2. Rolling	30° ; 3 to 9 cpm
3. Pitching	10° ; 4 to 15 cpm

*) cpm : cycle per minute

Table 4.5.1 Vertical Acceleration Necessary for Two Percent Variation of SG Feed Water Flow

Period of Acceleration (second)	5	7	10	15
Magnitude of Acceleration (g)	3.0	1.1	0.4	0.2

Table 4.5.2 Sinusoidal Steam Flow Variation Necessary for Control Rod Movement During Rated Power Operations

Period of Steam Flow Variation (second)	5	7	10	15
Magnitude of Steam Flow Rate (%)	2.1	2.0	2.0	1.9

Remark : Control rod movement is taken equivalent to temperature difference signal (ε) 0.6 ℃

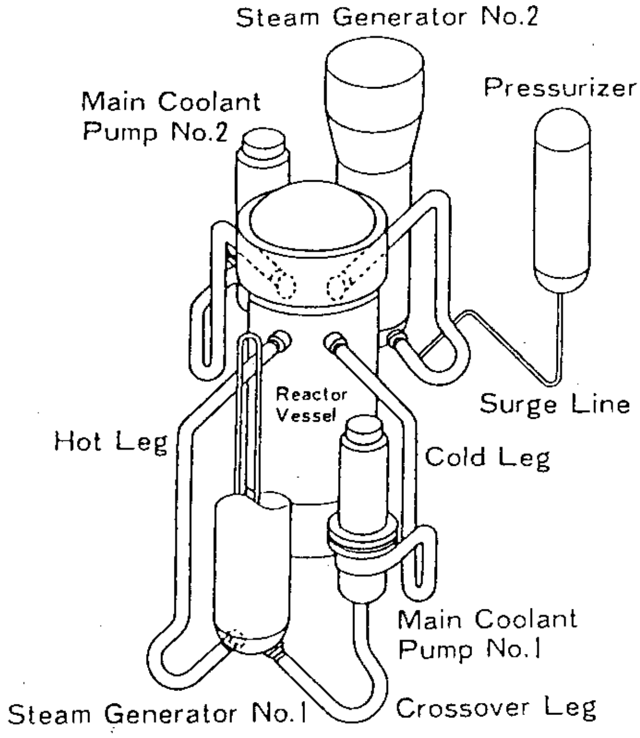
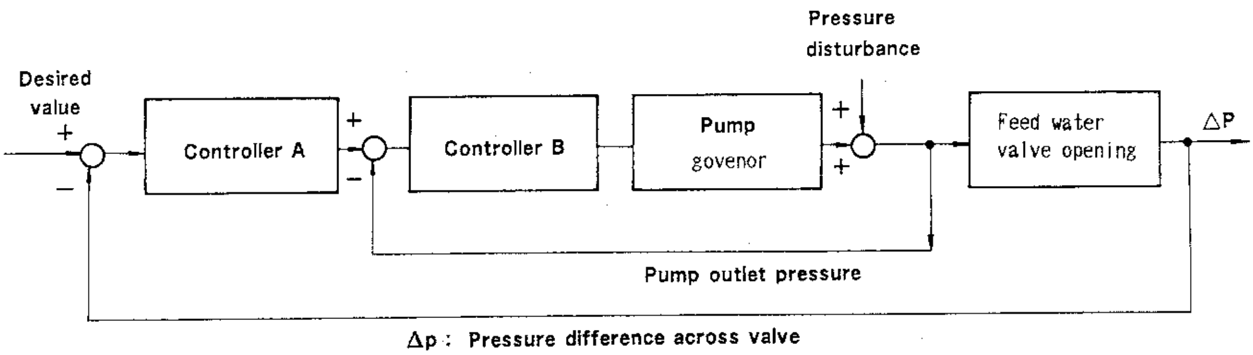


Fig. 4.1.1 Mutsu Reactor Coolant System



Controller A: Control of constant pressure difference across feed water valve
Controller B: Control of pump outlet pressure control

Fig. 4.1.2 MUTSU Feed Water Pump Controller System

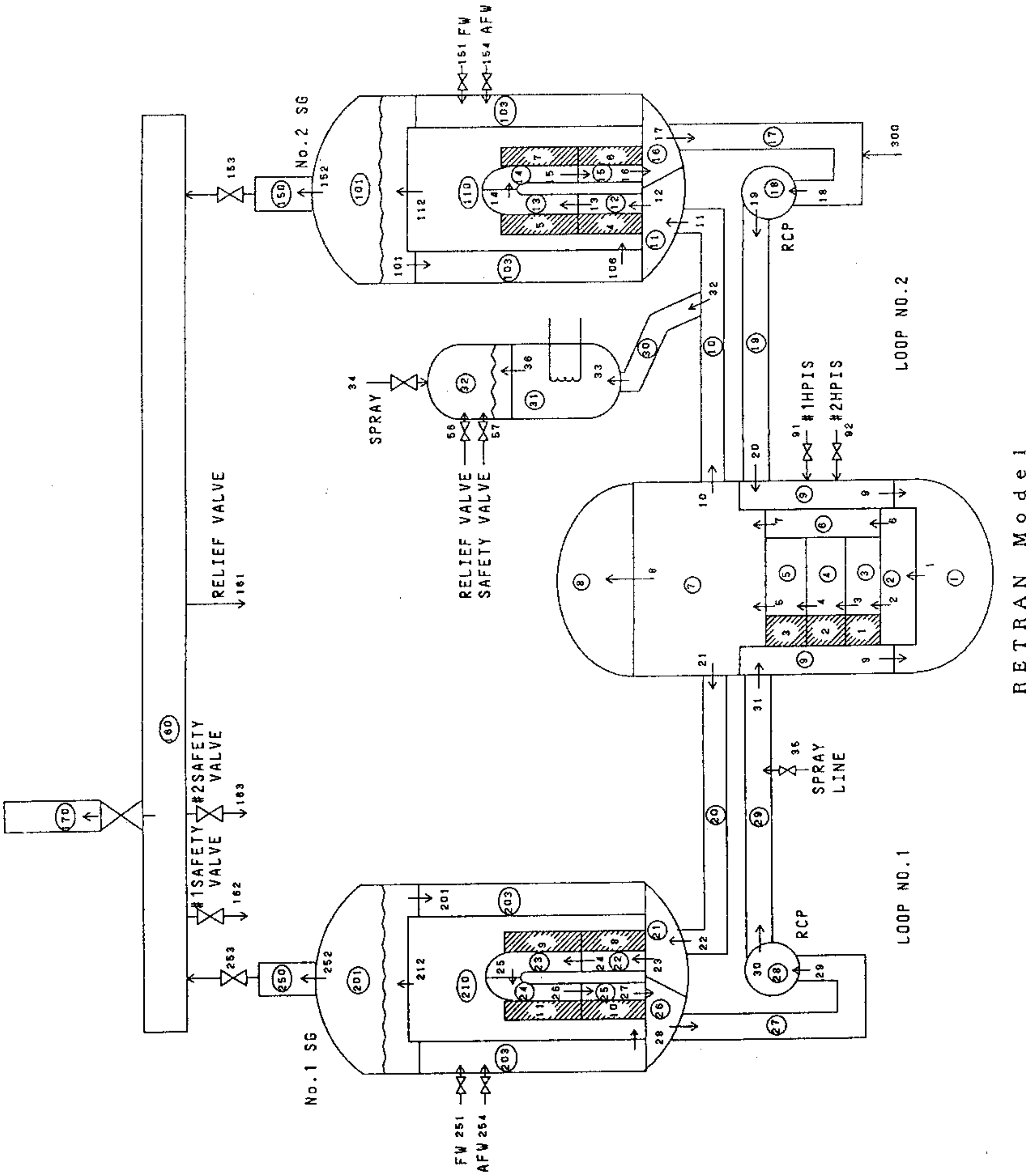


Fig. 4.1.3 RETRAN-02/GRAV Computational Nodalization for MUTSU Analysis

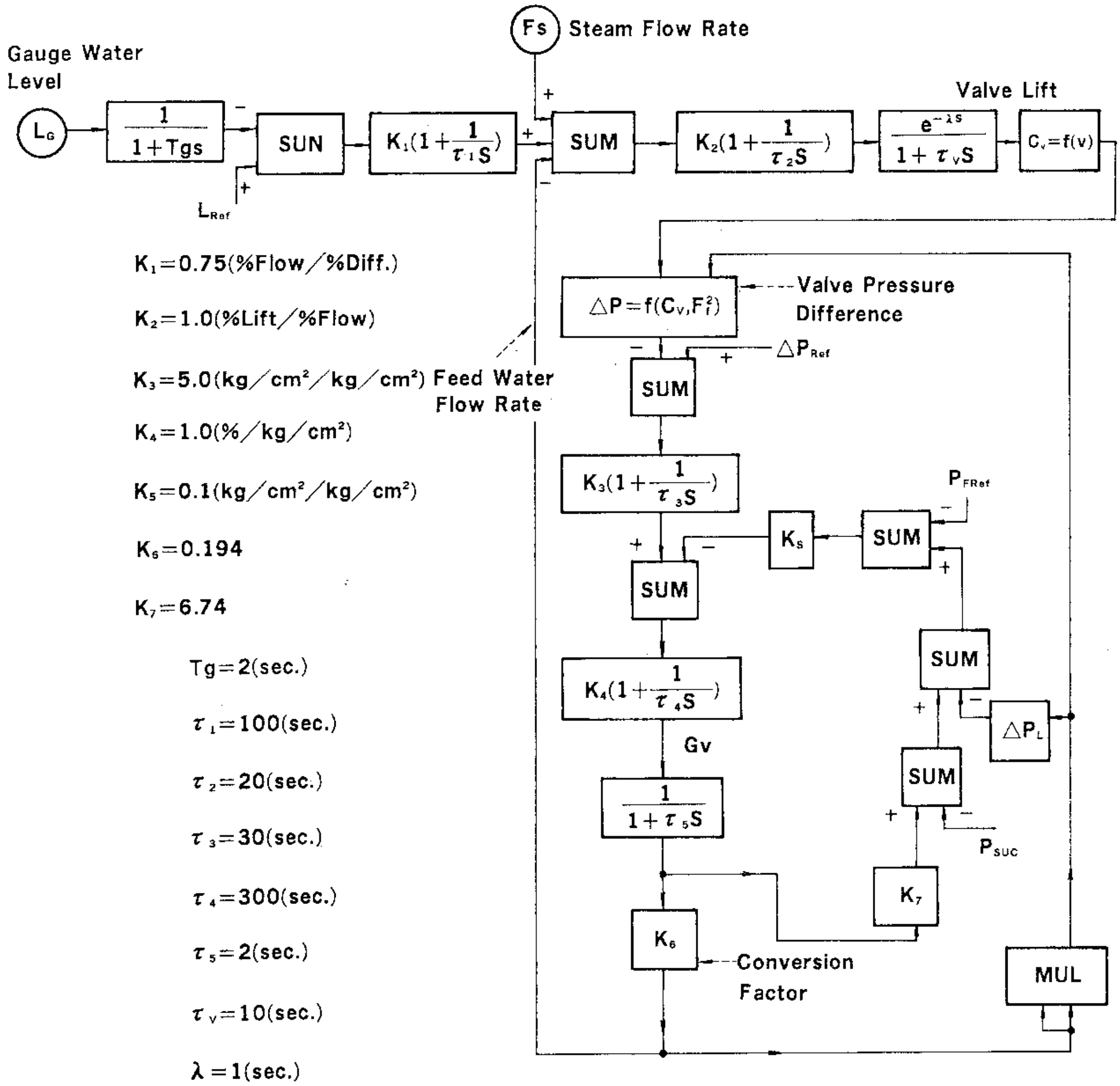
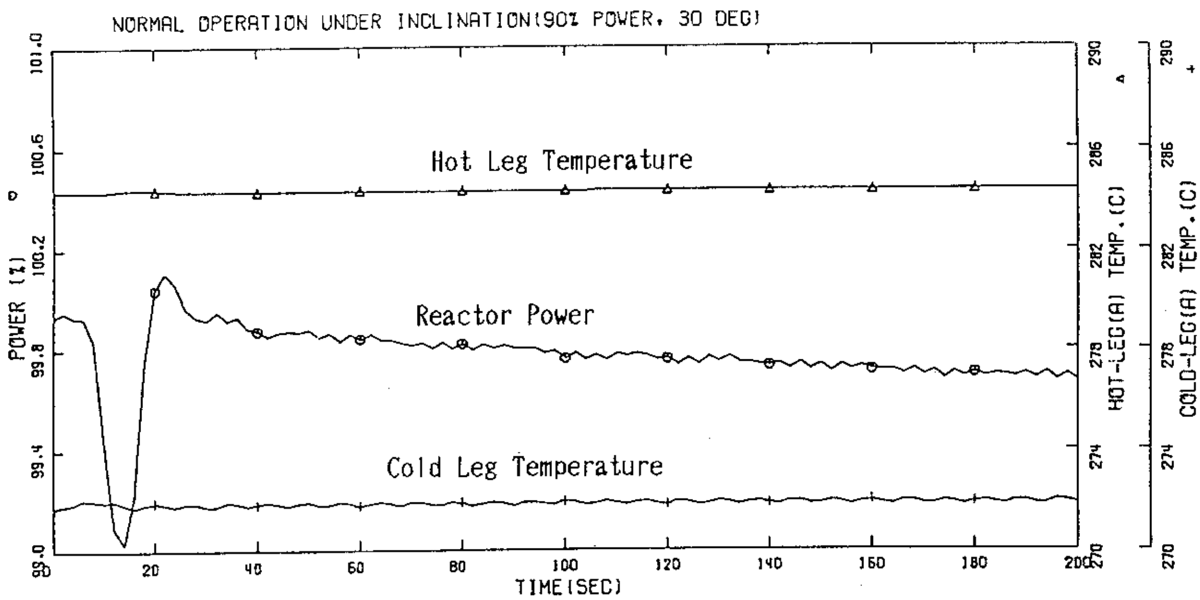
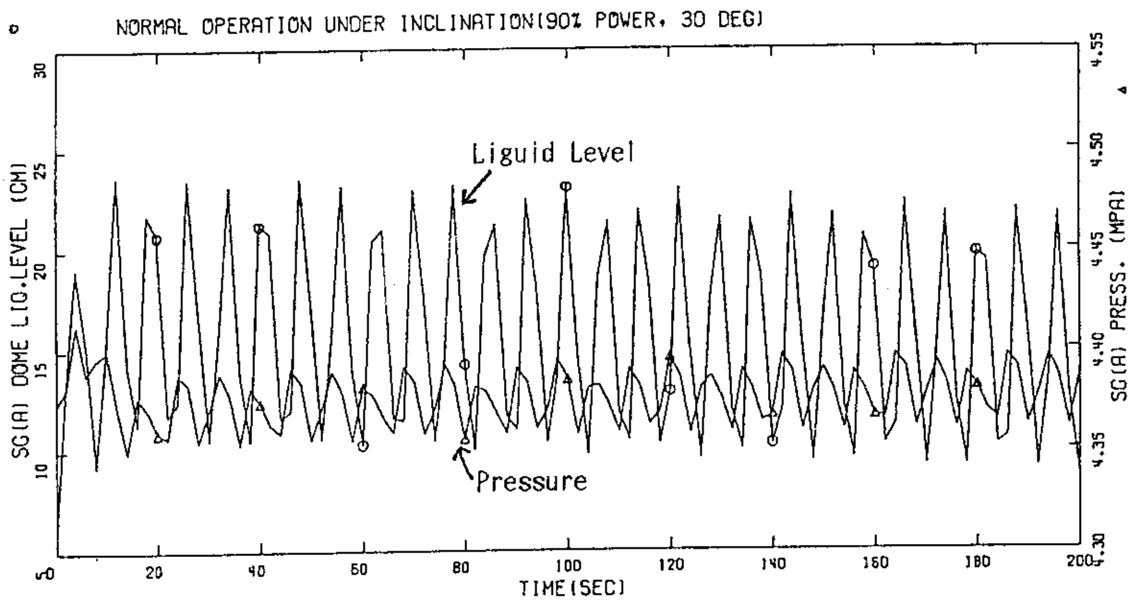


Fig. 4.1.4 RETRAN-02/GRAV Model of SG Feed Water Control System



(a)Primary Side Parameters (Power,Hot and Cold Leg Temperature)



(b)SG Secondary Side Parameters (Liquid Level and Pressure)

Fig. 4.2.1 Analysis of Mutsu Reactor Response to Ship Inclination During Normal Power Operation

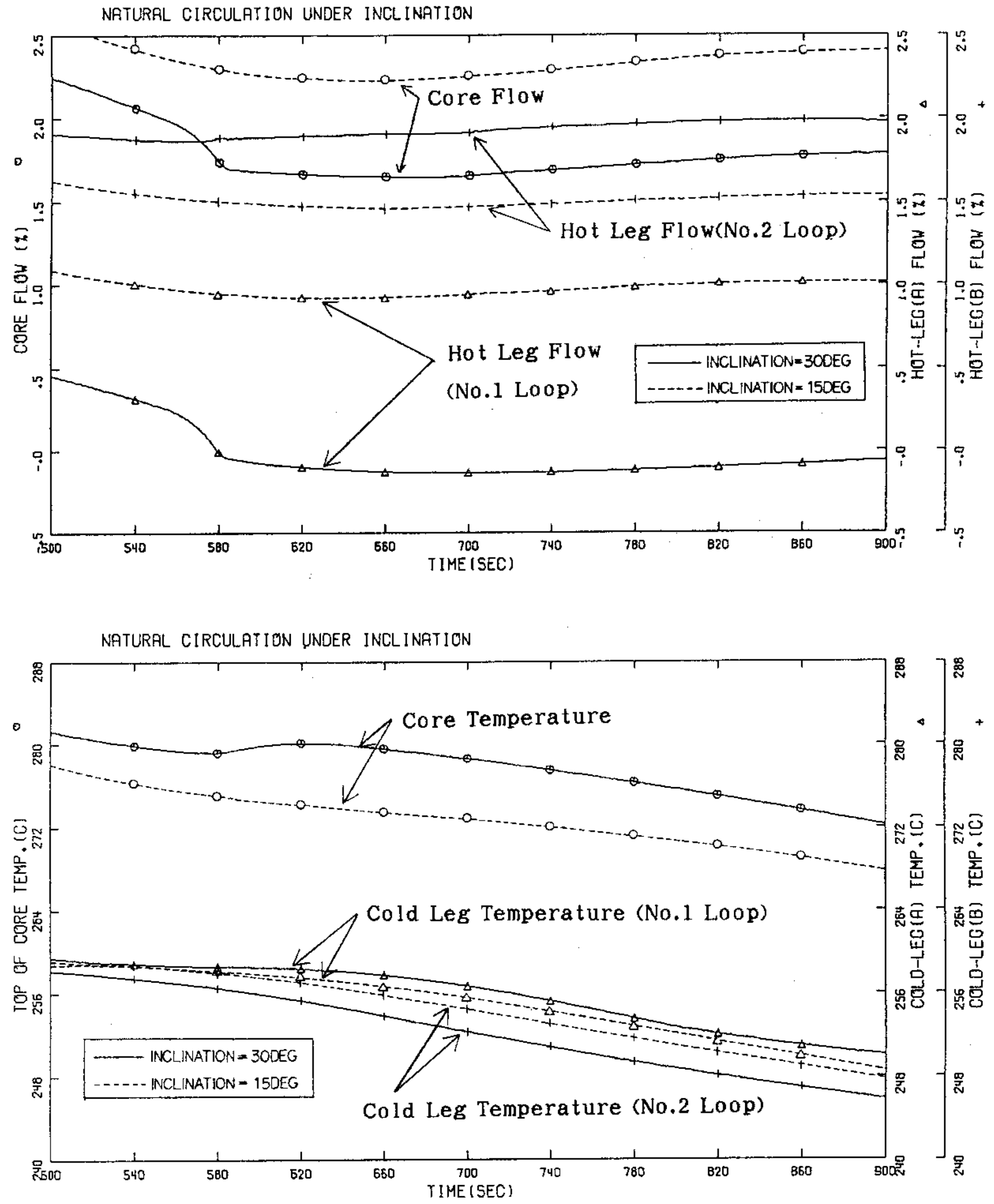


Fig. 4.2.2 Analysis of Natural Circulation at Inclination (Reactor Tripped at 30 Seconds and Main Coolant Pumps Tripped at 75 Seconds)

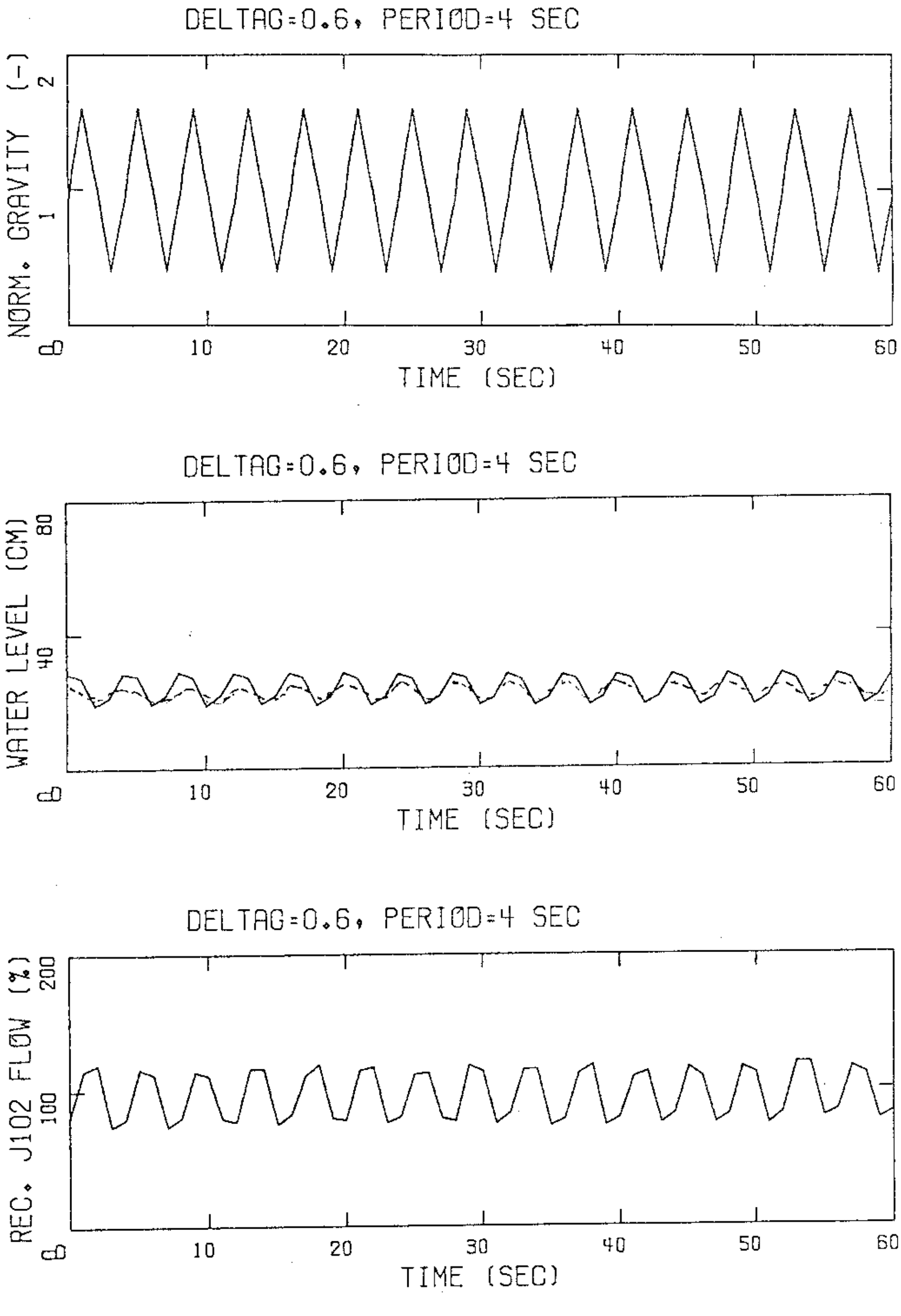


Fig. 4.3.1(1) Analysis of Response of Mutsu SG Water Level and Re-Circulation Flow at Heaving During Rated Power Operation
(a) Δg = 0.6g, Period = 4 sec.
(——— Present Analysis
- - - Design Analysis)

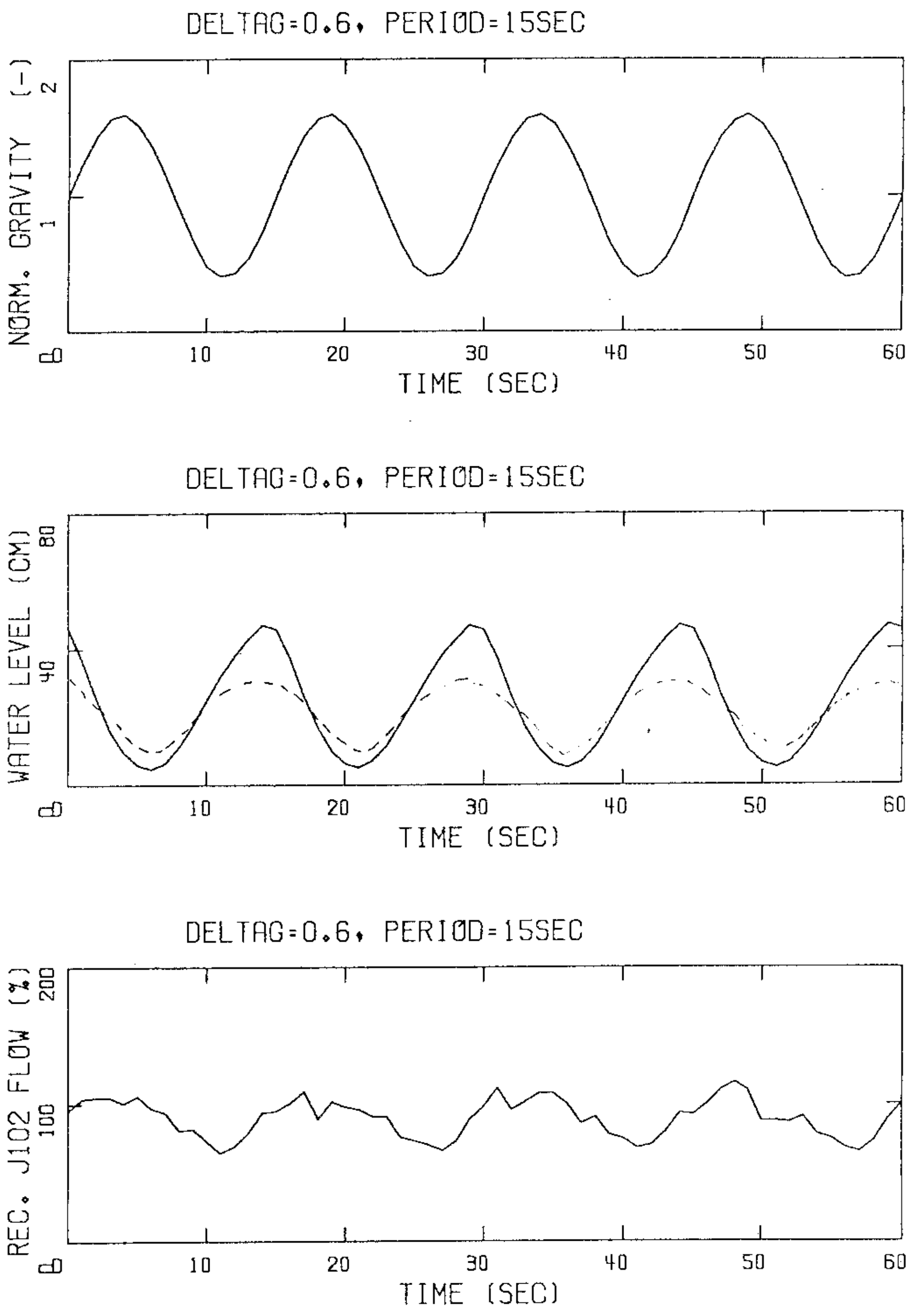


Fig. 4.3.1(2) Analysis of Response of Mutsu SG Water Level and Re-circulation Flow at Heaving During Rated Power Operation
(b) Δg = 0.6g, Period = 15 sec.
(——— Present Analysis
- - - Design Analysis)

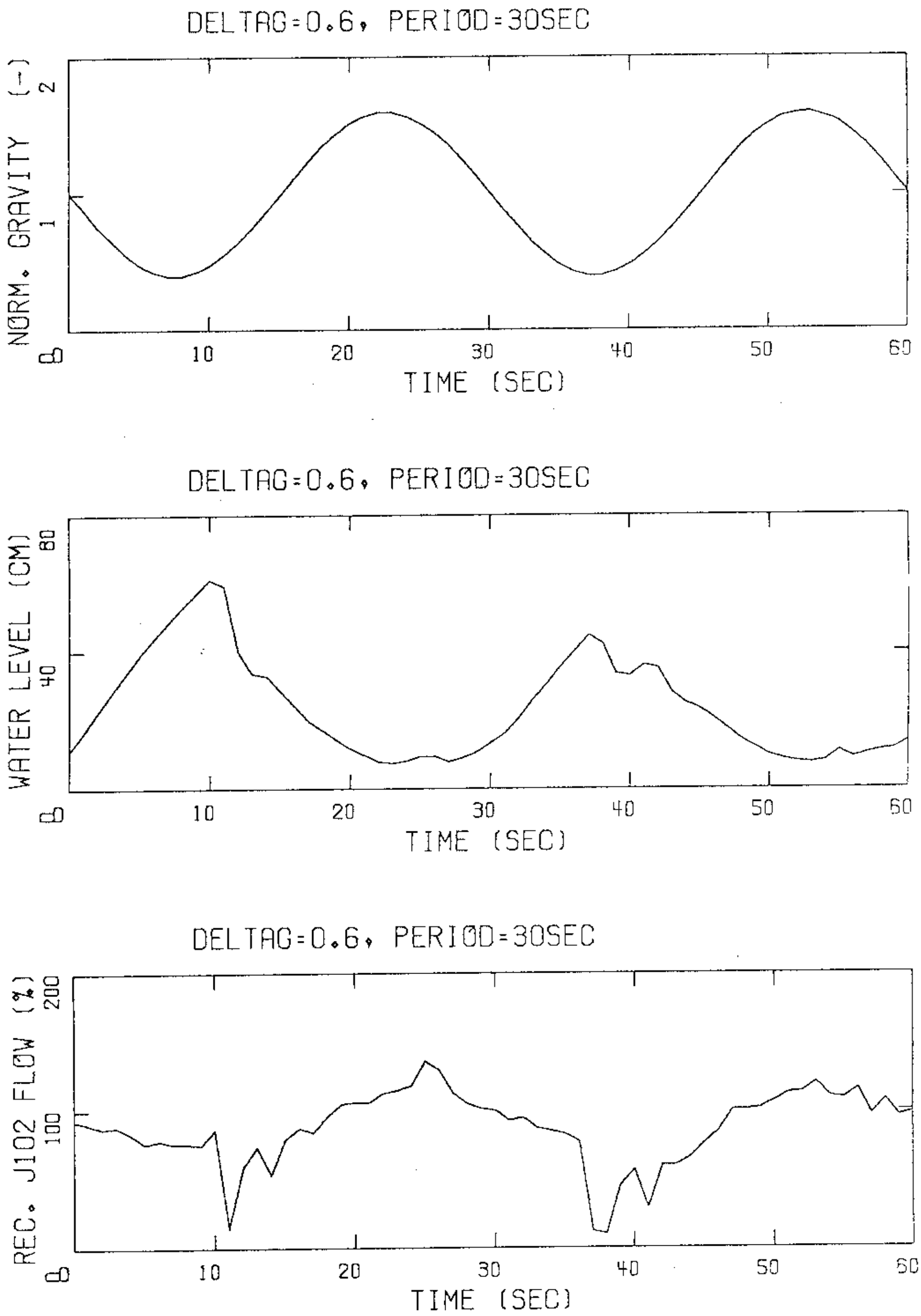


Fig. 4.3.1(3) Analysis of Response of Mutsu SG Water Level and Re-circulation Flow at Heaving During Rated Power Operation
(c) Δg = 0.6g, Period = 30 sec.

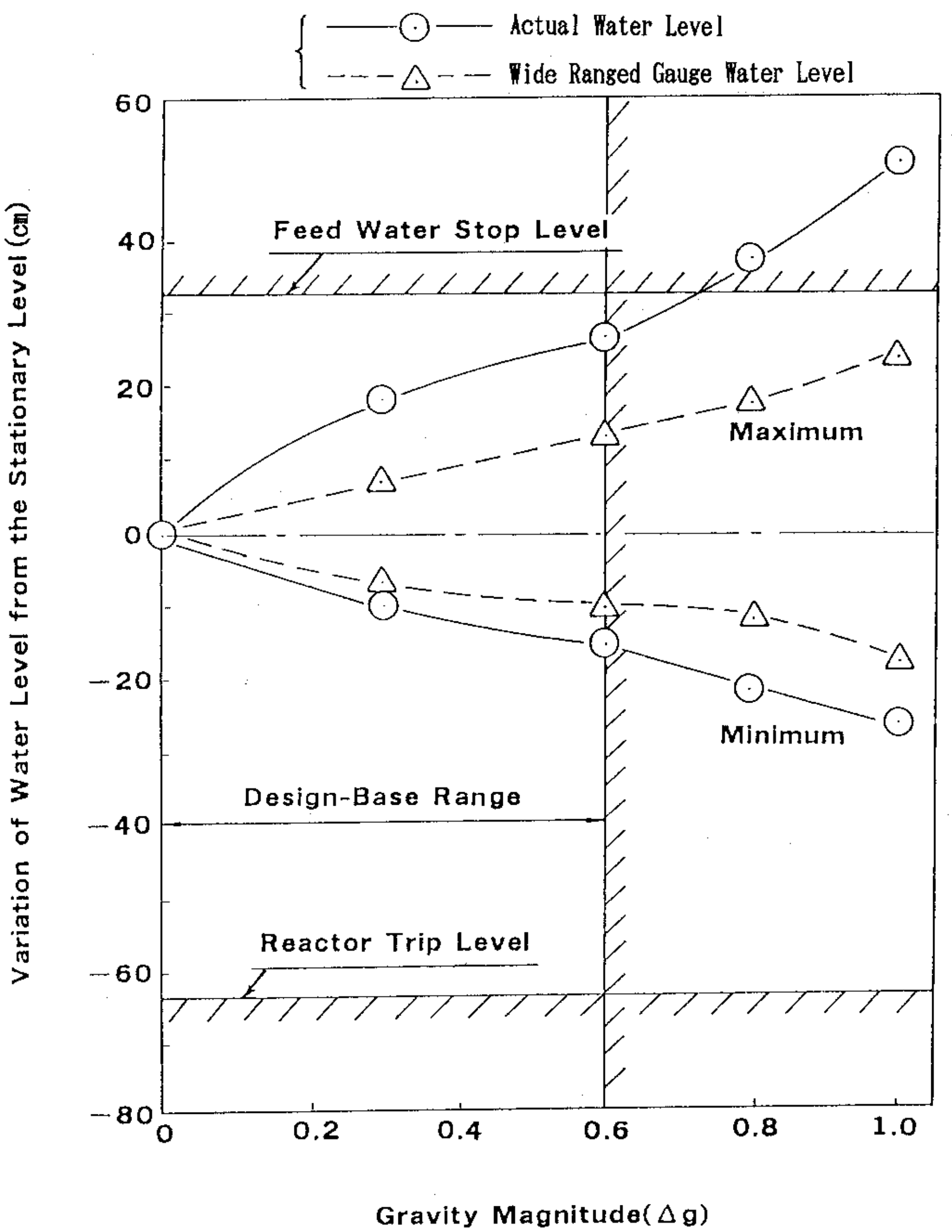
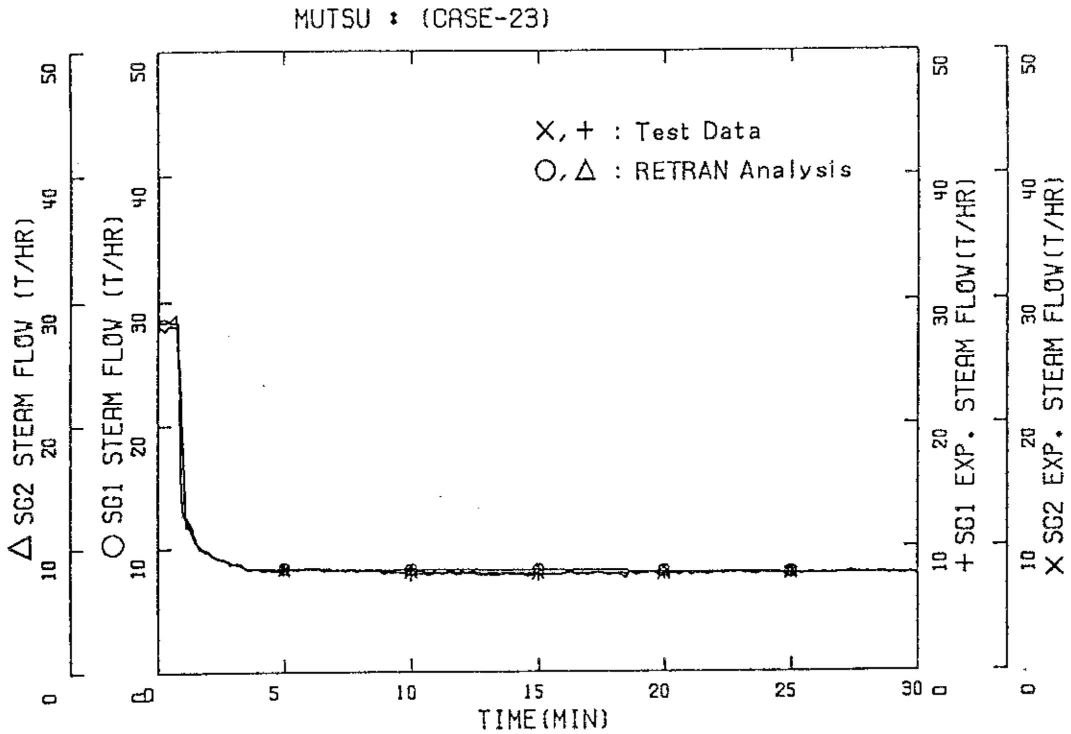
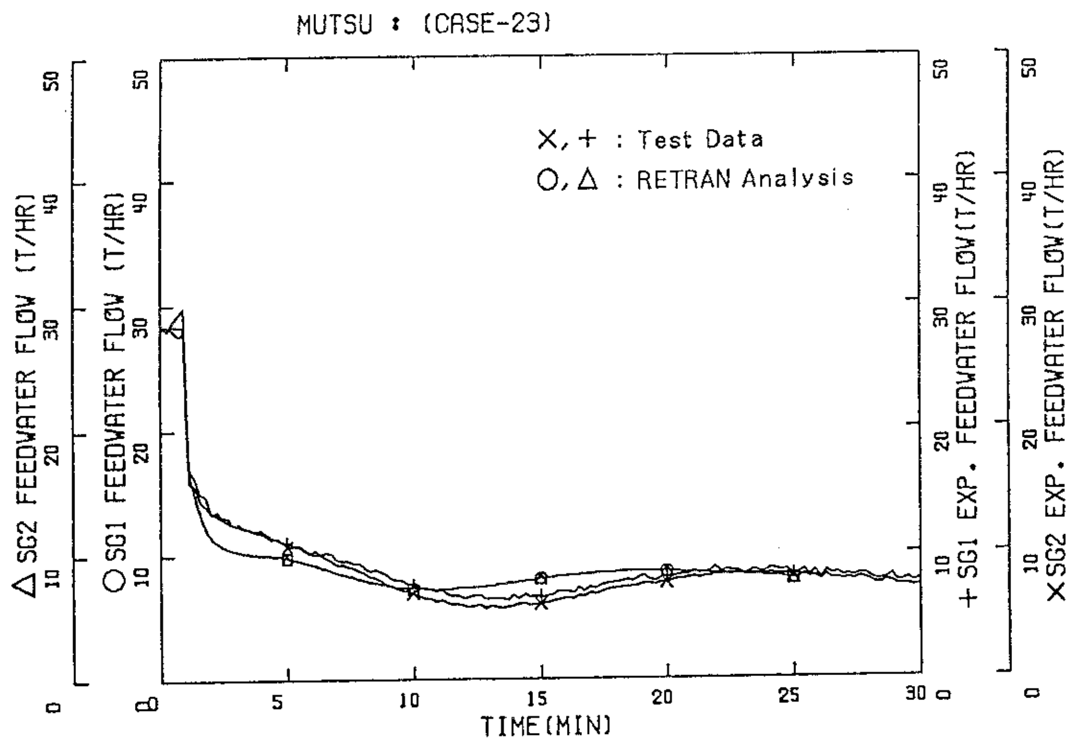


Fig. 4.3.2 Variation of SG Water Level and Gauge Water Level at Acceleration Period of 15 Seconds During Rated Power Operation

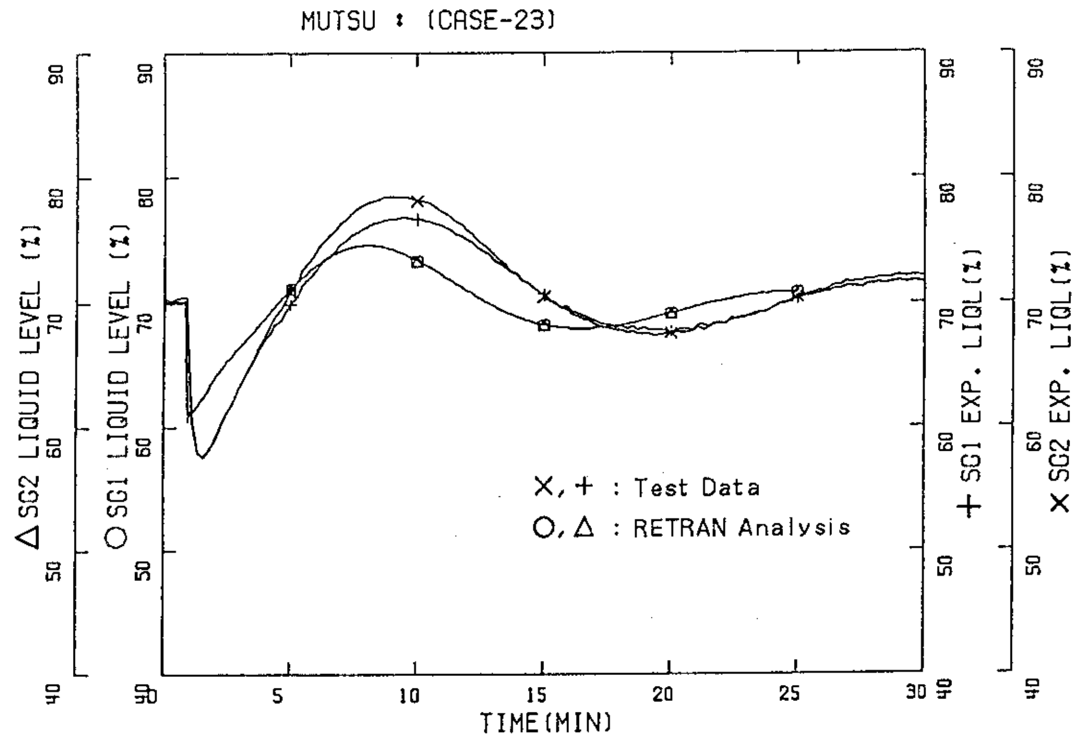


Steam Flow Rate

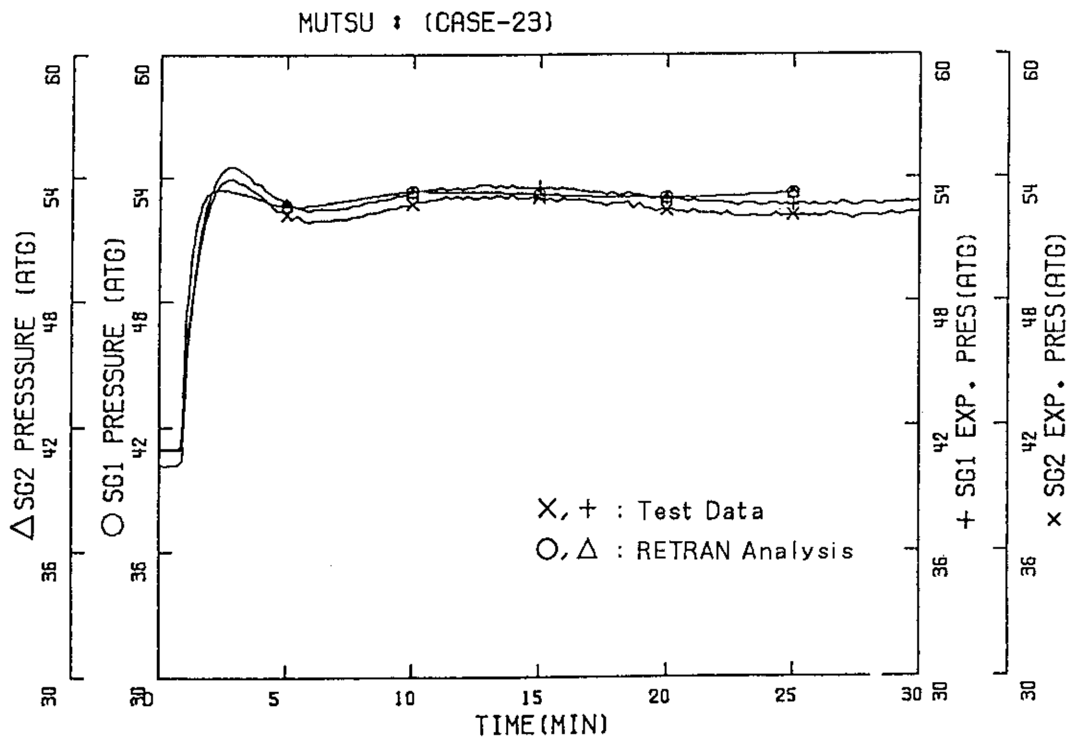


Feed Water Flow Rate

Fig. 4.3.3(1) Turbine Trip Test of Mutsu Without Ship Motion (Changes of Steam Flow Rate and Feed Water Flow Rate)

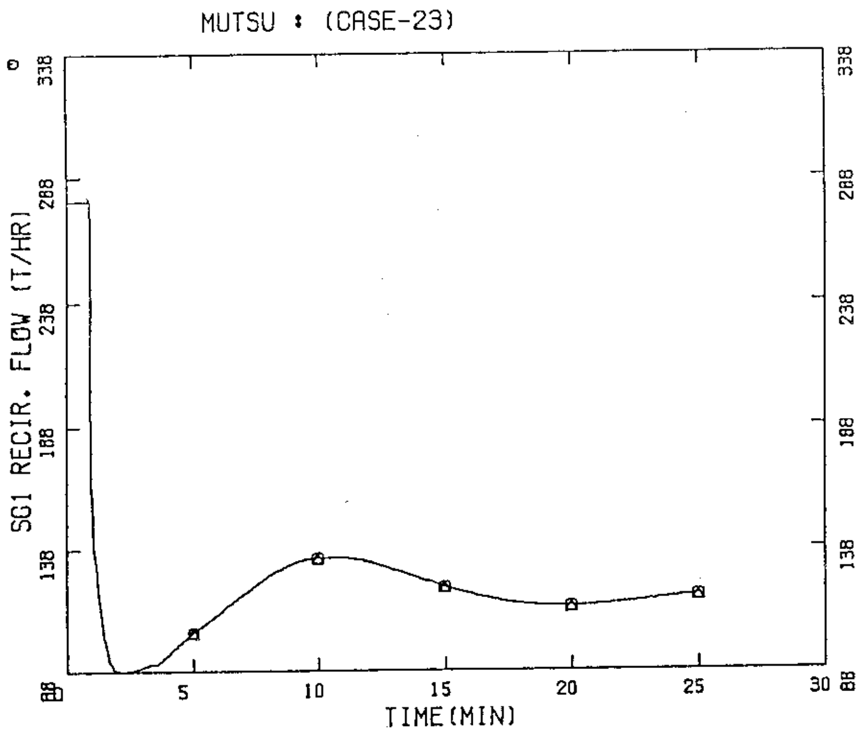


SG Gauge Level (Narrow Ranged)

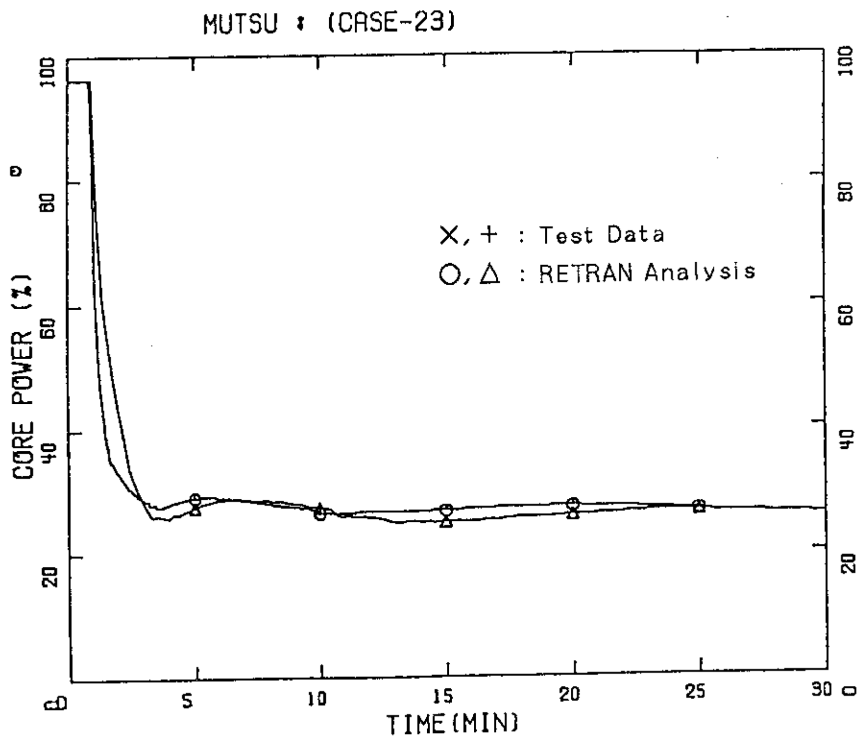


SG Pressure

Fig. 4.3.3(2) Turbine Trip Test of Mutsu Without Ship Motion
(Changes of Narrow Ranged SG Water Level and SG Pressure)

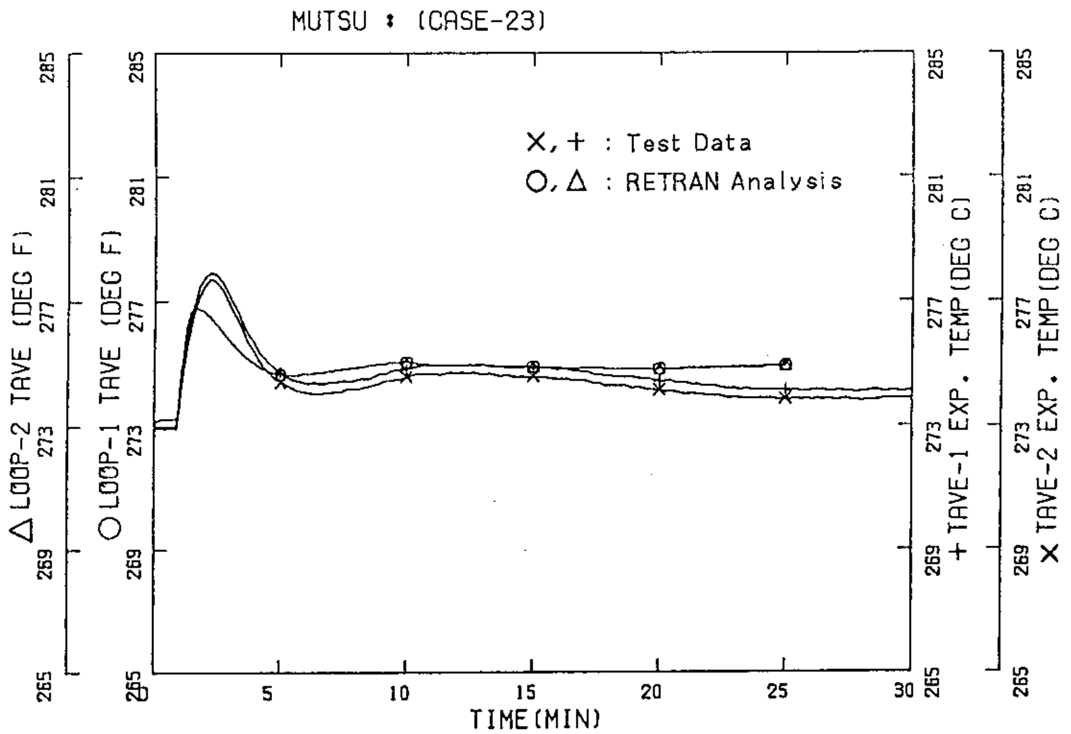


SG Re-Circulation Flow

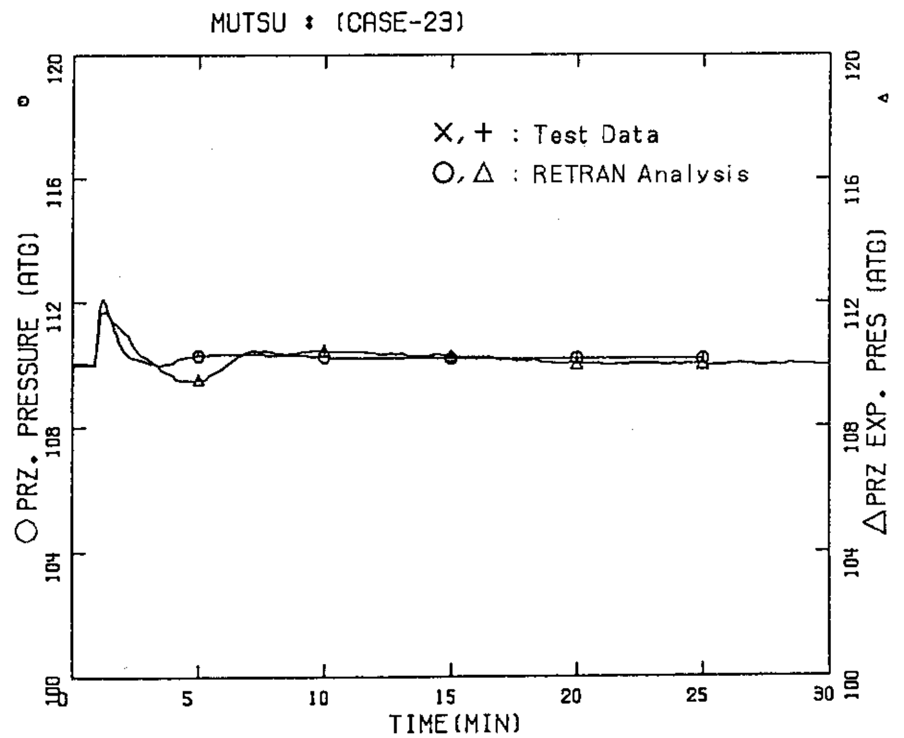


Reactor Power

Fig. 4.3.3(3) Turbine Trip Test of Mutsu Without Ship Motion
(Changes of SG Re-Circulation Flow and Reactor Power)

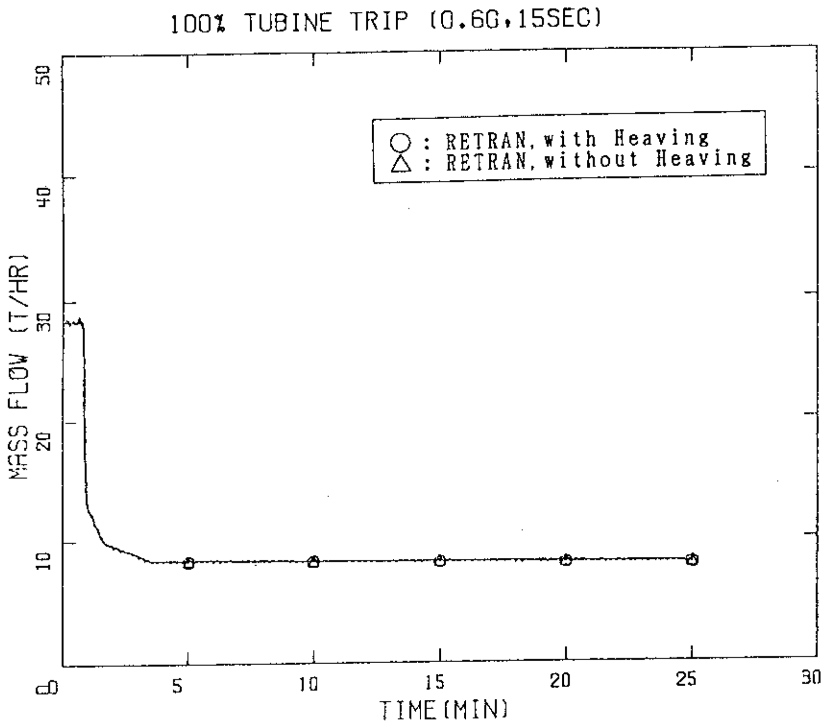


Primary Loop Average Temperature

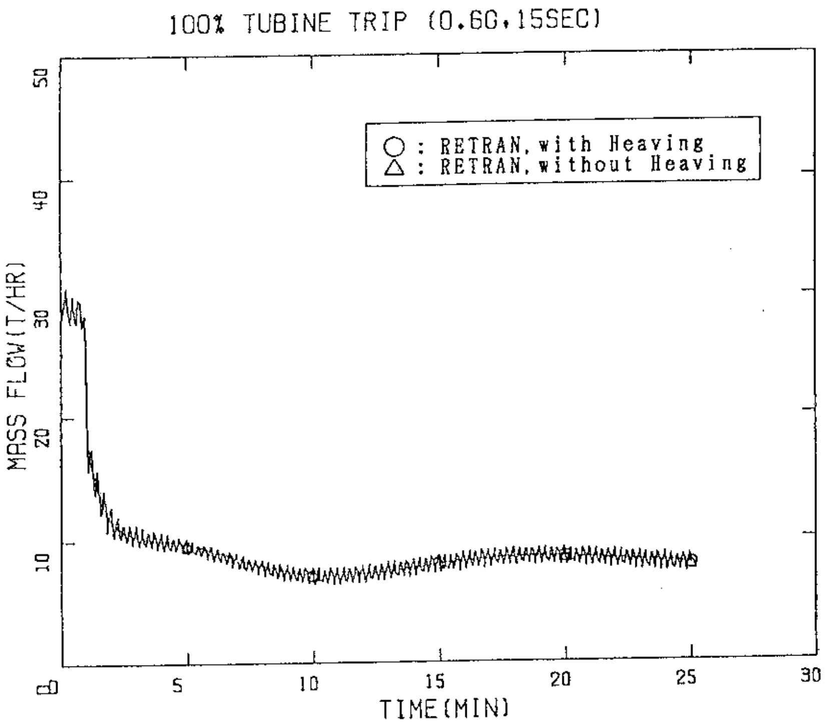


Pressurizer Pressure

Fig. 4.3.3(4) Turbine Trip Test of Mutsu Without Ship Motion (Changes of Primary Loop Temperature and Pressurizer Pressure)



No. 1 SG Steam Flow



No. 1 SG Feed Water Flow

Fig. 4.3.4(1) Comparison of Transients With Heaving (0.6 g, 15 Seconds) and Without Heaving at Turbine Trip of Mutsu (Changes of No.1 SG Steam Flow and Feed Water Flow)

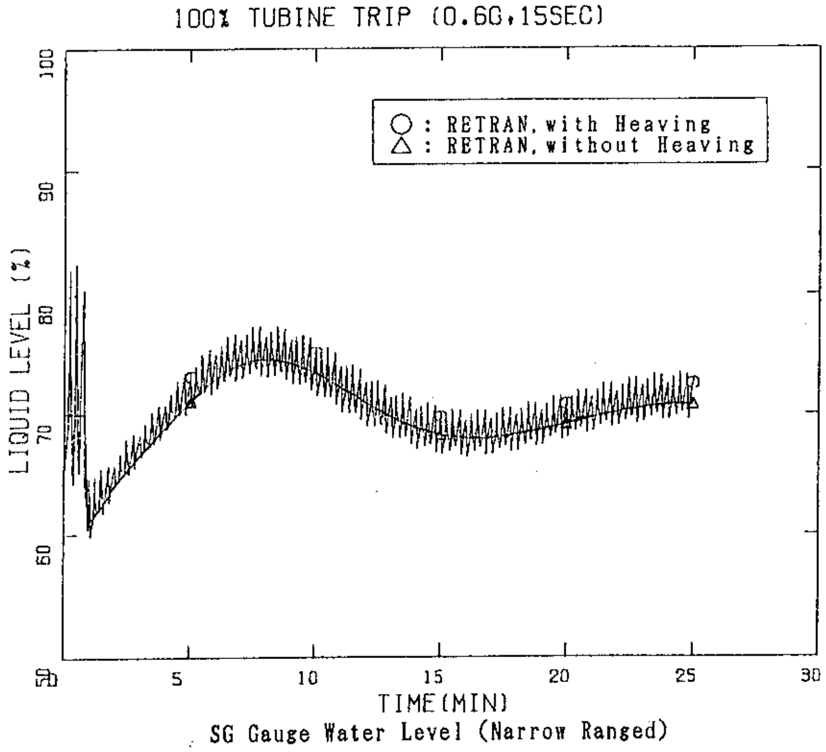
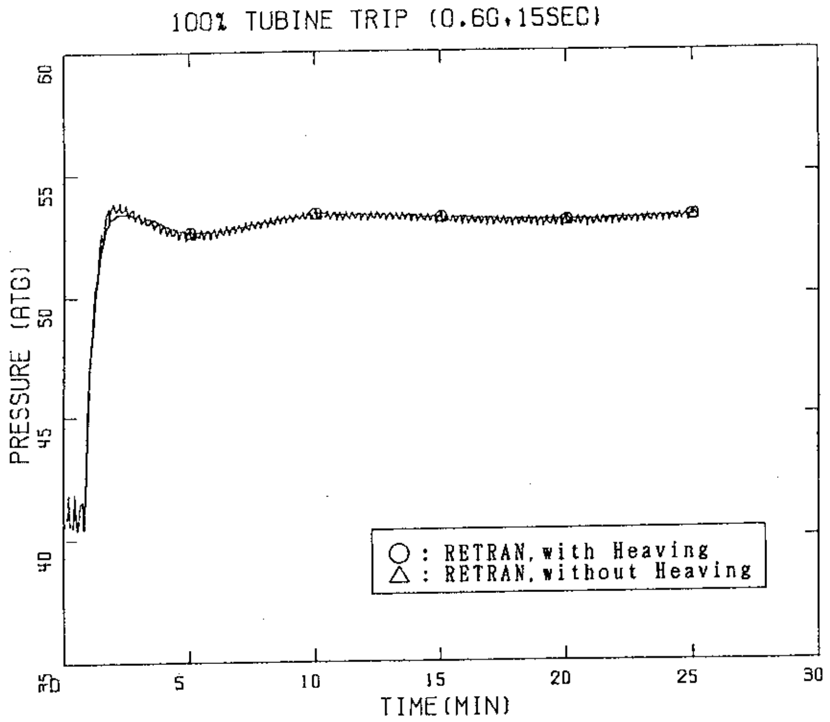
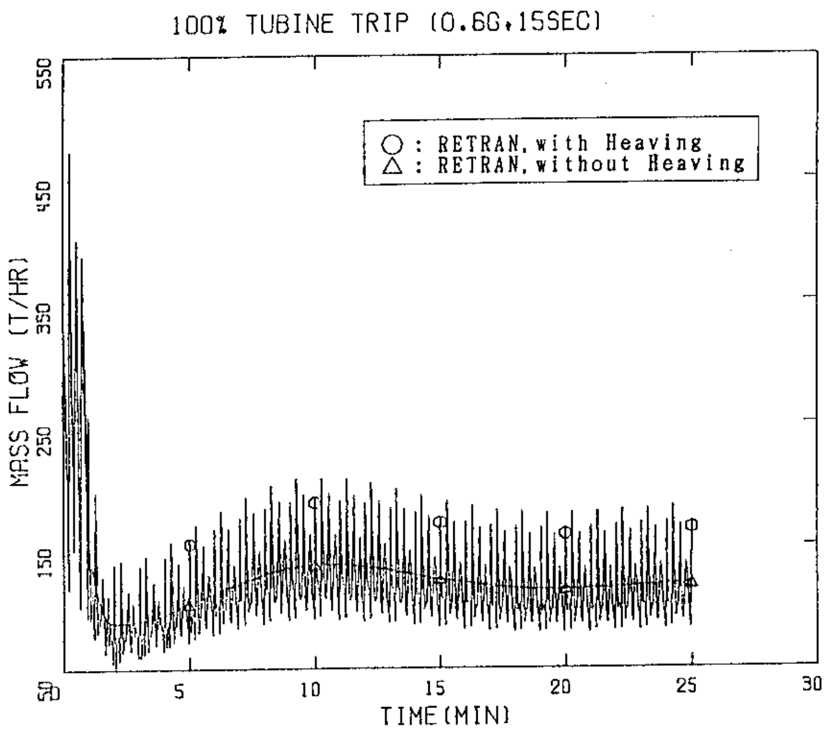


Fig. 4.3.4(2) Comparison of Transients With Heaving (0.6 g, 15 Seconds) and Without Heaving at Turbine Trip of Mutsu (Changes of No.1 SG Water Levels: Actual and Narrow Ranged Water Levels)

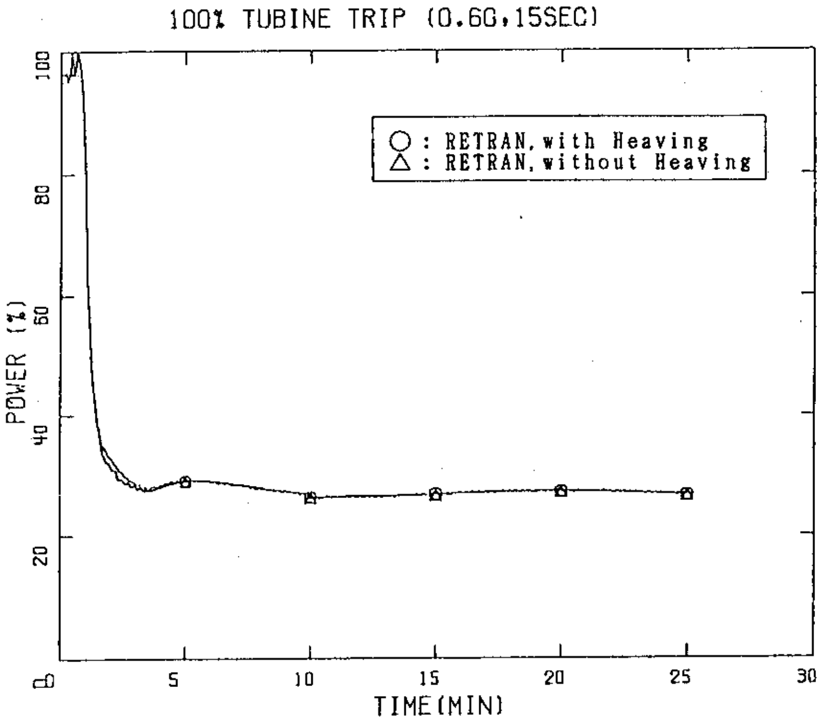


No.1 SG Pressure

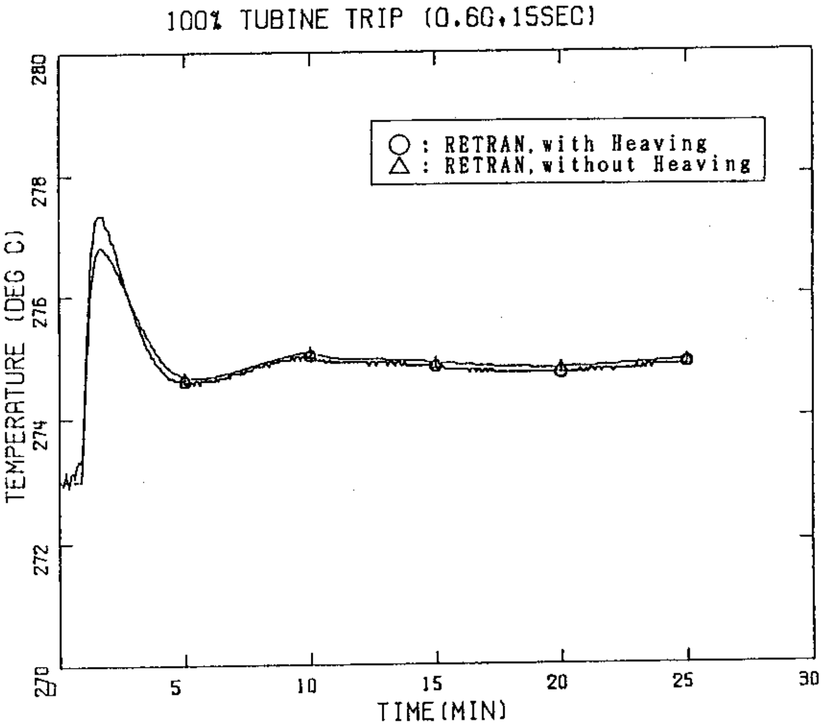


No.1 SG Re-Circulation Flow

Fig. 4.3.4(3) Comparison of Transients With Heaving (0.6 g, 15 Seconds) and Without Heaving at Turbine Trip of Mutsu (Changes of No.1 SG Pressure and No.1 SG Re-Circulation Flow)

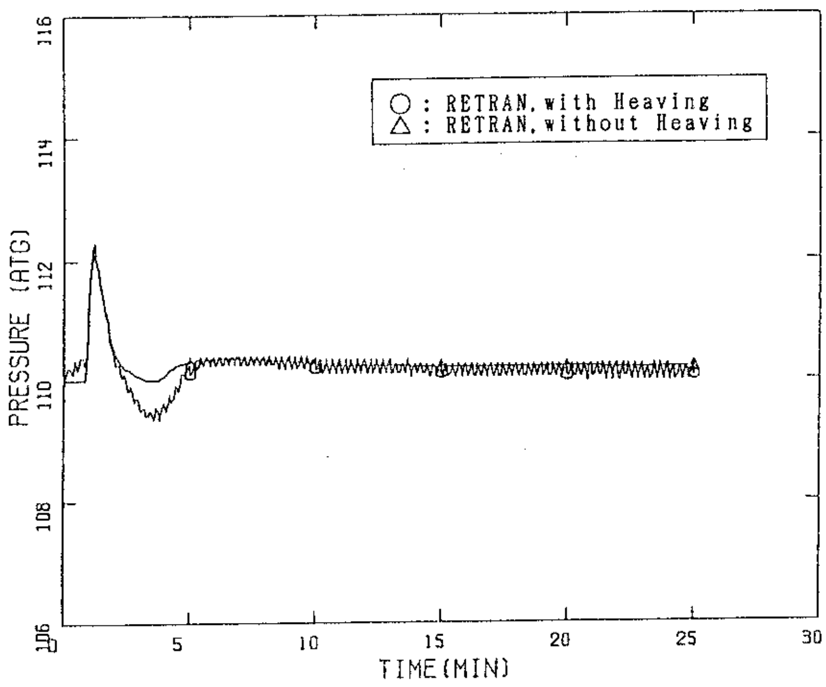


Reactor Power

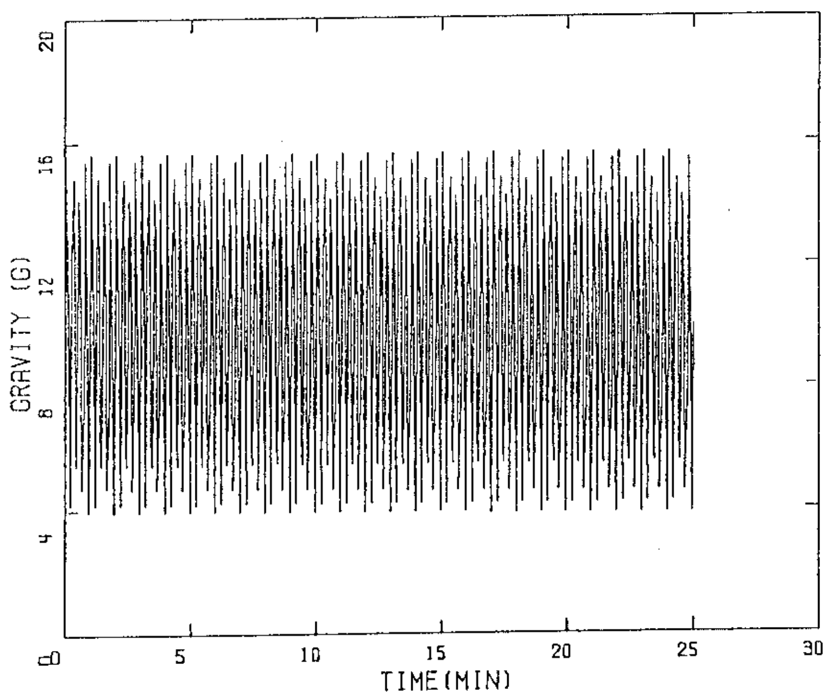


Primary Loop Average Temperature

Fig. 4.3.4(4) Comparison of Transients With Heaving (0.6 g, 15 Seconds) and Without Heaving at Turbine Trip of Mutsu (Changes of Reactor Power and Primary Loop Average Temperature)

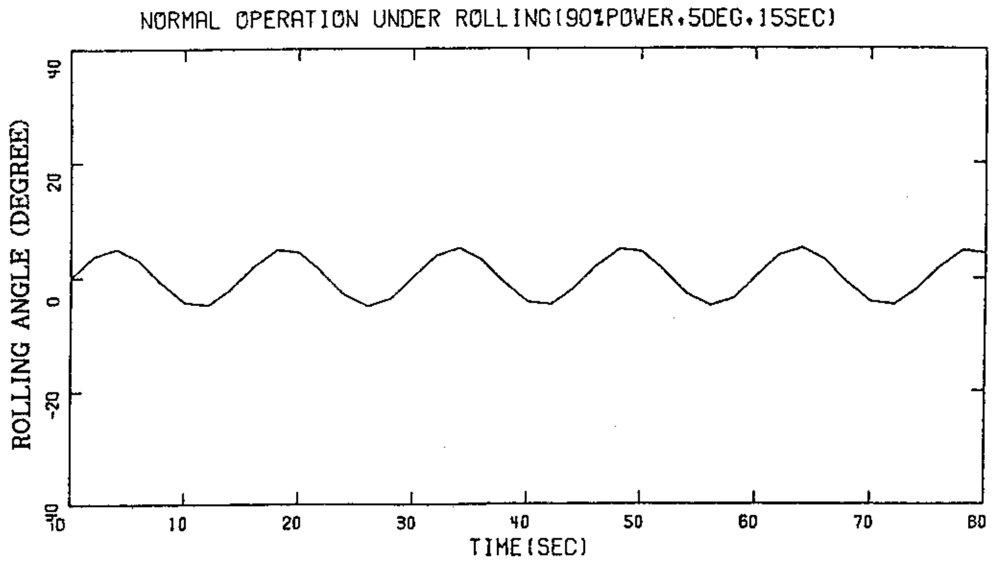


Pressurizer Pressure



Acceleration by Heaving(± 0.6g, 15seconds)

Fig. 4.3.4(5) Comparison of Transients With Heaving (0.6 g, 15 Seconds) and Without Heaving at Turbine Trip of Mutsu (Changes of Pressurizer Pressure and Acceleration by Heaving)



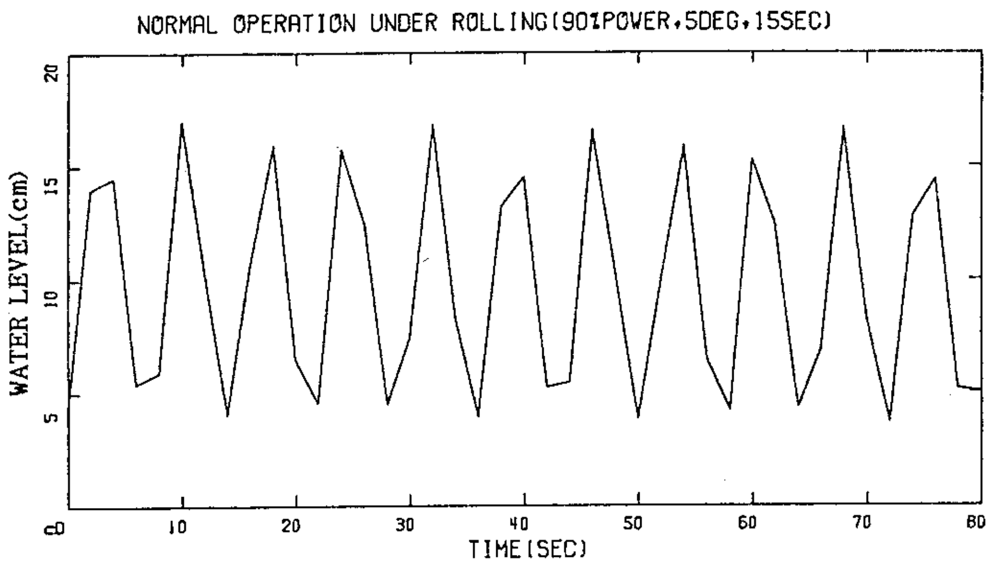
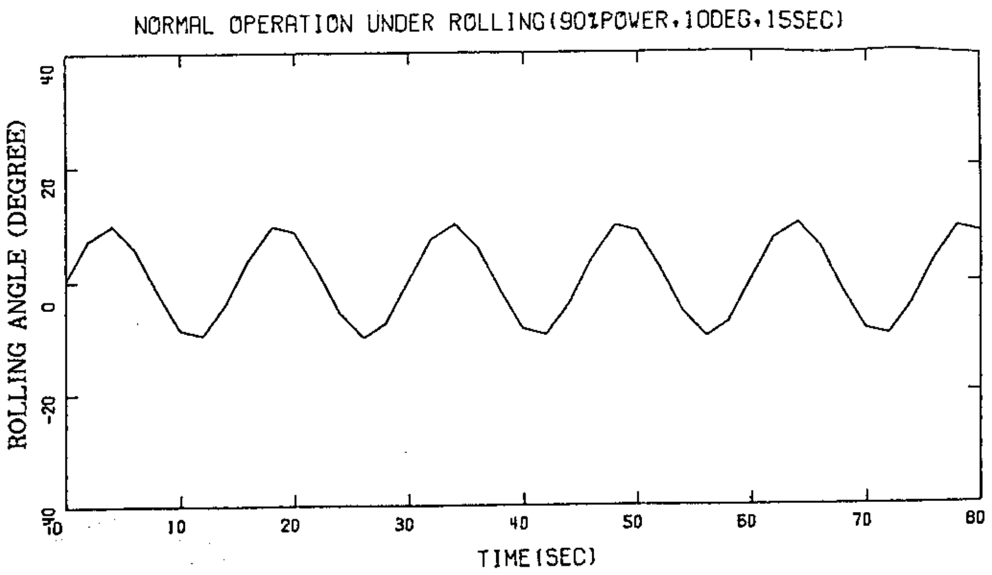


Fig. 4.4.1(1) Analysis of Response of Mutsu SG Water Level Under Rolling During Normal Power Operation (Angle=5 Degrees, Period=15 Seconds)



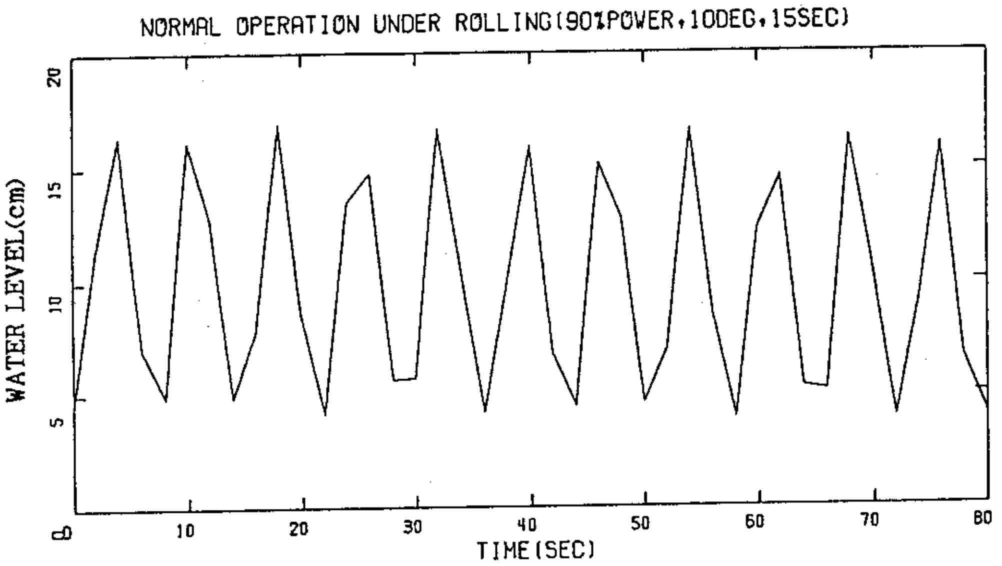
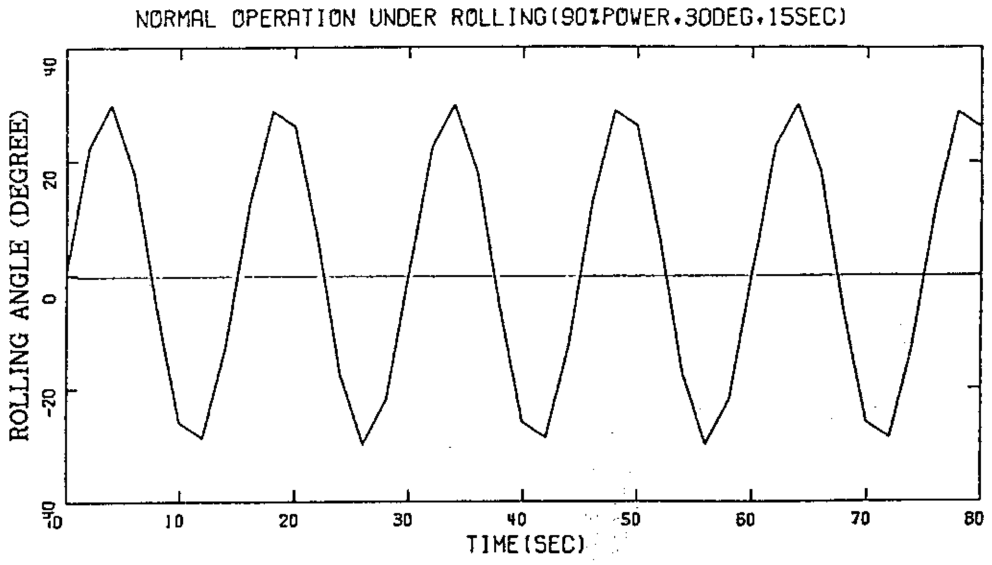


Fig. 4.4.1(2) Analysis of Response of Mutsu SG Water Level Under Rolling During Normal Power Operation (Angle=10 Degrees, Period=15 Seconds)



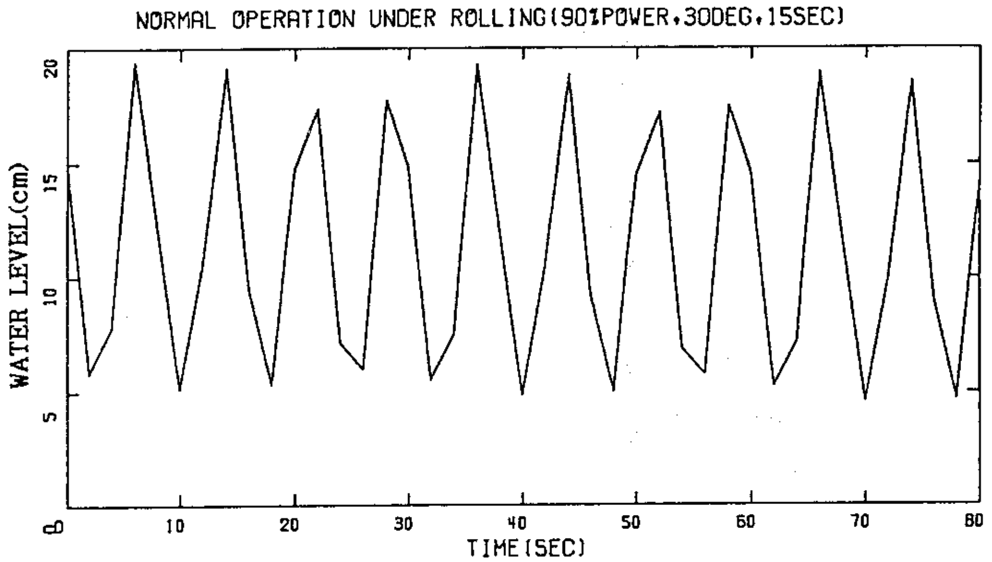


Fig. 4.4.1(3) Analysis of Response of Mutsu SG Water Level Under Rolling During Normal Power Operation (Angle=30 Degrees, Period=15 Seconds)

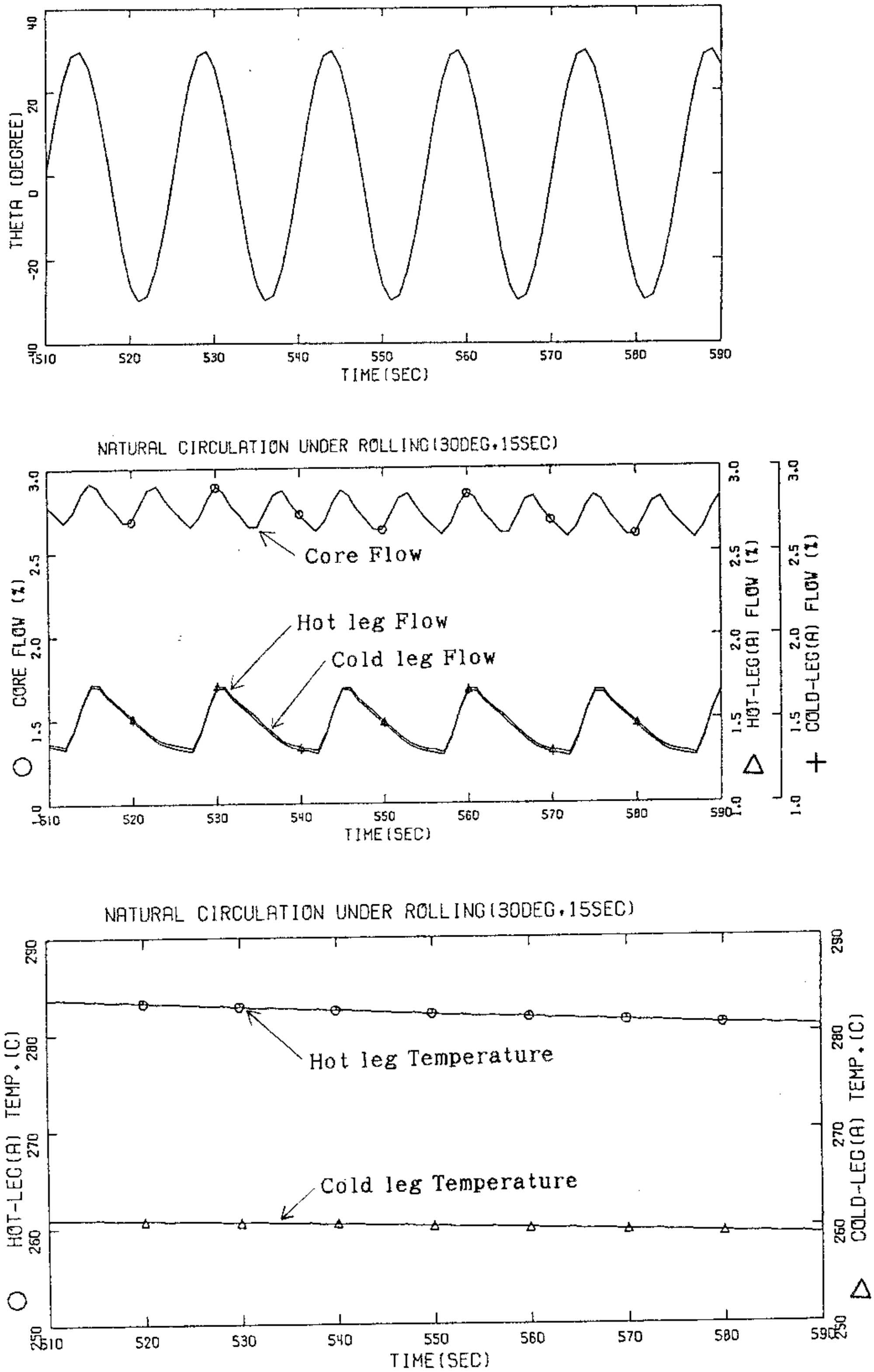


Fig. 4.4.2 Analysis of Natural Circulation Under Rolling (Rolling Angle=30 Degrees, Period=15 Seconds): Reactor Tripped at 30 Seconds and Main Coolant Pumps Tripped at 75 Seconds

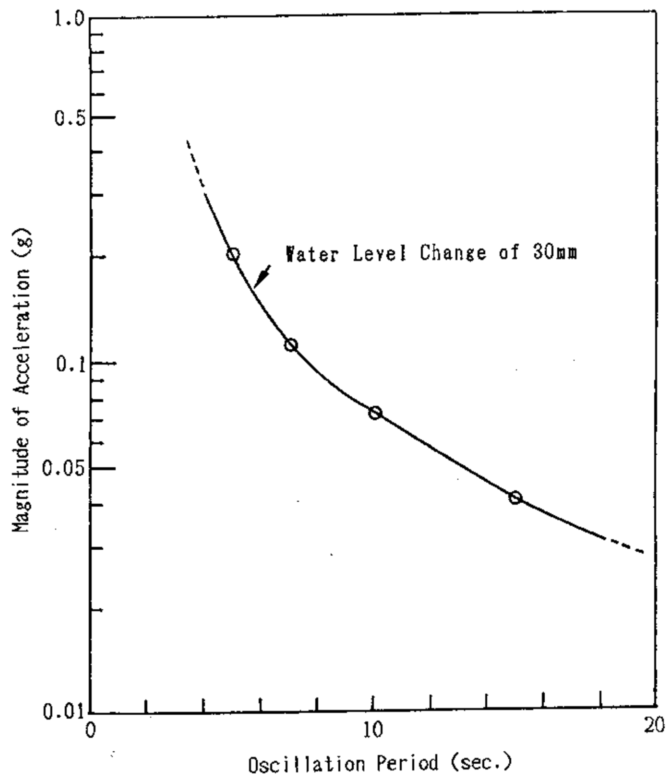


Fig. 4.5.1 Vertical Acceleration for 30mm Variation of SG Actual Water Level

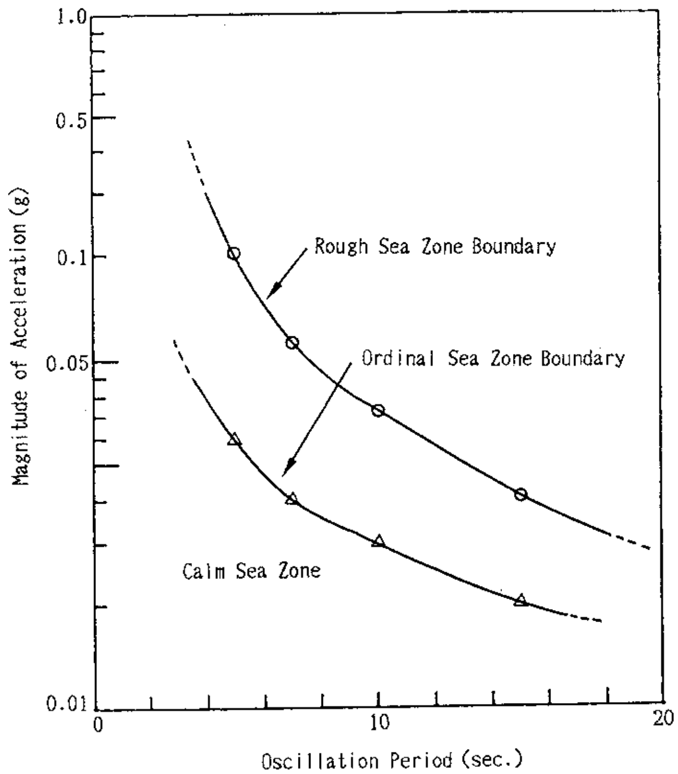


Fig. 4.5.2 Vertical Acceleration Recommended for Mutsu Experimental Voyage

5. Conclusions

We have been improved a thermal hydraulic code RETRAN-02 for analysis of marine reactor dynamics under ship motion such as heaving, rolling. For ship motion and inclination, the code has been modified for ship motion and inclination so as to treat two-dimensional or three-dimensional effects in the the momentum equation and the energy equation, and to calculate the flow out entalphy of the volume with water level, in connection with control logic model. Improvements on the following ship motions have been performed.

(1) For stationary inclination of ship, the water head term in the equations and the water level model are modified so as to simulate inclination of the two-dimensional plane.

(2) For heaving, the vertical time-dependent accelerations are added to the equations.

(3) For rolling, the tangential force and centrifugal force together with time-dependent inclination are introduced in the equations.

(4) Arbitrary rotation of ship is modelled by taking account of the three-dimensional movements by introducing the centrifugal force and the tangential force as well as the co-ordinate transformation matrix.

To verify the improved functions of the present code, the following experimental analyses have been performed.

(1) Single-phase natural circulation experiment at some inclined attitudes

(2) Single-phase and two-phase natural circulation flows under heaving

(3) Single-phase natural circulation flow during rolling motion

The results show that the analyse have simulated well the experiments and that the validity of the improved code has been proved. However, the effect of acceleration or inclination due to ship motion on the heat transfer coefficient and the steam-water void fraction are not taken account in the present version. These correlations should be experimentally studied.

As applications of the improved code RETRAN-02/GRAV, the N.S. Mutsu has been analysed for providing quantitative bases for planning of the experiment in her experimental voyage. The acceleration conditions for her voyages are recommended.

Acknowledgements

The authors would like to express their appreciations to Mr. Masa-aki OCHIAI of JAERI and Mr. Yukihisa YABUSHITA of IEA of Japan for their useful suggestions, Mr. Takeharu ISE for his laborious review of the present paper, and Katumi TODA first engineer and other engineers of N.S. Mutsu for their valuable information.

As applications of the improved code RETRAN-02/GRAV, the N.S. Mutsu has been analysed for providing quantitative bases for planning of the experiment in her experimental voyage. The acceleration conditions for her voyages are recommended.

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NOMENCLATURE

A_k	= flow area of volume k
c	= elevation of volume center
e	= elevation
e^*	= total energy per unit mass
F_w	= friction pressure gradient due to wall
f_h	= horizontal acceleration
f_v	= vertical acceleration
g_z	= axial component of acceleration due to gravity
$g(t)$	= time dependent gravitation acceleration
h_i	= specific fluid enthalpy of junction i
L_i	= length in volume i
M_i	= total mass in volume i
P_i	= thermodynamic pressure in volume i
Q_{wm}	= energy exchange rate between channel wall and fluid
R	= distance for co-ordinates
T_a	= period of oscillation
t	= time
U_i	= total internal energy in volume i
u_i	= average specific internal energy in volume i
V_k	= control volume used in the averaging procedure for volume k
v_k	= average fluid velocity in volume k
W	= net mass flow
W_i	= mass flow for junction i
$\overline{W}_i$	= average mass flow in volume i
Z_i	= volume center height above reference height z
Z_i	= junction height above reference height z

GREEK LETTERS

α	= acceleration for each axis
β	= normalized gravitation acceleration
$\beta(t)$	= time dependent normalized gravitation acceleration
γ	= flow length of volume for three-dimension
ζ	= rotation angle around x axis
θ	= rotation angle around y axis
ρ_i	= mixture density in volume i
$\overline{\rho}_i$	= fluid density in volume i
ϕ	= rotation angle around z axis
$\lvert\ \rvert$	= absolute value

APPENDIXES

A.1 Source list of improved program in RETRAN-02/GRAV

Following SUBROUTINEs are modified.

(No.)	SUBROUTINE name	(Remark)
①	ID05	Assign for Rolling variable
②	ID06	Assign for Rolling variable
③	CONTRL	Improvement for control block function
④	DERIVS	Improvement for control block function
⑤	EDINIT	Improvement for control block function
⑥	HEAD	Improvement for gravity and rolling
⑦	INCNT1	Modification for input
⑧	INJUN	Modification for input
⑨	INPUT	Modification for input
⑩	INVOL	Modification for input
⑪	JSVEL	Modification for gravity
⑫	RETRAN	Modification for gravity
⑬	WATER	Modification for steam function
⑭	ENTRAN	Modification for slip SSI
⑮	HAVG	Modification for slip SSI
⑯	SFR	Modification for slip SSI
⑰	SLIPHW	Modification for slip SSI
⑱	TOMGST(newly made)	Controller for gravity and rolling
⑲	MATMLT(newly made)	Controller for gravity and rolling
⑳	ROLXYZ(newly made)	Controller for gravity and rolling

SUBROUTINE No.

```
¥LOCATE ID05
CIEA                                                                        ID050416
C      PARAMETERS REQUIRED FOR ROLLING OPTION
C
       DIMENSION RAD3DX(1),RAD3DY(1),RAD3DZ(1)
       DIMENSION VOL3DX(1),VOL3DY(1),VOL3DZ(1)                                         ①
       EQUIVALENCE  (RSTOR(100),RAD3DX(1)),  (RSTOR(101),RAD3DY(1)),
      *             (RSTOR(102),RAD3DZ(1)),  (RSTOR(103),VOL3DX(1)),
      *             (RSTOR(104),VOL3DY(1)),  (RSTOR(105),VOL3DZ(1))
CIEA END
¥LOCATE ID06
CIEA START                                                                  ID060386
C      PARAMETERS REQUIRED FOR ROLLING OPTIONS
C
       DIMENSION
      * IWT1(1), IWT2(1)
       EQUIVALENCE
      *(RSTOR(91),IWT1(1))   ,(RSTOR(92),IWT2(1))
CIEA END                                                                               ②
¥INSERT
*COMDECK TOMG                                                               TOMG0005
       COMMON / TOMGFC /                                                    TOMG0015
      * TR(3,3), TOMGF, TOMGH                                               TOMG0020
      *         ,ITOMGF,ITOMGH                                              TOMG0025
      *, PHIZ, PHIZD, PHI2D, THEY, THEYD, THE2D, ZETX, ZETXD, ZET2D         TOMG0030
      *,IPHIZ,IPHIZD,IPHI2D,ITHEY,ITHEYD,ITHE2D,IZETX,IZETXD,IZET2D         TOMG0035
*END
¥LOCATE CNTR XX
       IF(J1.LT.1.OR.J1.GT.19)GOTO 605                                      CNTR0410
       GOTO(211,212,213,214,215,216,217,218,219),J2                         CNTR0430
 2210  CONTINUE                                                             CNTR0751
       GO TO 295                                                            CNTR0871
C                                                                           CNTR0872
C      SINE BLOCK                                                           CNTR0873
  216  COUT(ID) = SIN(COUT(INC1(ID)))                                       CNTR0874
       GO TO 295                                                            CNTR0875
C                                                                           CNTR0876
C      COSINE BLOCK                                                         CNTR0877   ③
  217  COUT(ID) = COS(COUT(INC1(ID)))                                       CNTR0878
       GO TO 295                                                            CNTR0879
C                                                                           CNTR0880
C      EXPONENTIAL BLOCK                                                    CNTR0881
  218  COUT(ID) = EXP(COUT(INC1(ID)))                                       CNTR0882
       GO TO 295                                                            CNTR0883
C                                                                           CNTR0884
C      ABSOLUTE BLOCK                                                       CNTR0885
  219  COUT(ID) = ABS(COUT(INC1(ID)))                                       CNTR0886
C                                                                           CNTR0887
C      CODING FOR ADDITIONAL TYPES OF CONTROL BLOCKS GOES HERE              CNTR0888
       DIVISR = 1.0                                                         CNTR0995
       GO TO 2210                                                           CNTR0996
¥LOCATE DERI XX
*CALL TOMG                                                                  DERI0061
CIEA   BTUFP = ONE/FPBTU                                                    DERI0150
       TBTUFP = ONE/FPBTU
CIEA                                                                                   ④
CIEA                                                                        DERI0161
       BTUFP = TBTUFP*TOMGF
CIEA
¥LOCATE EDIN XX
CN150  RETURN                                                               EDIN1800
  150  CONTINUE
       CALL TOMGST(MODE,IDXF,IFIL,DD)                                                  ⑤
       RETURN
CIEA
¥LOCATE HEAD XX
*CALL TOMG                                                                  HEAD0086
       DIMENSION RELXYZ(3),ZMXYZ(3),CMSXYZ(3),ACCXYZ(3)
       EQUIVALENCE
      * (RELXYZ(1),RELZX),(RELXYZ(2),RELZY),(RELXYZ(3),RELZZ)
      *,( ZMXYZ(1),ZMX),   ( ZMXYZ(2),ZMY),   ( ZMXYZ(3),ZMZ)
      *,(CMSXYZ(1),CMASX),(CMSXYZ(2),CMASY),(CMSXYZ(3),CMASZ)
      *,(ACCXYZ(1),ACCX), (ACCXYZ(2),ACCY), (ACCXYZ(3),ACCZ)
CIEA   DATA ZERO / 0.0 /, HALF / 0.5 /, ONE / 1.0 /                         HEAD0095
       DATA ZERO / 0.0 /, HALF / 0.5 /, ONE / 1.0 /, TWO / 2.0 /
       DATA EPS  / 1.E-8 /                                                             ⑥
CIEA END
CIEA                                                                        HEAD0236
       CALL ROLXYZ(I,    RELZ,RELXYZ)
       CALL ROLXYZ(I,  ZM(I), ZMXYZ)
```

```
      CALL ROLXYZ(I,CHAS(I),CHSXYZ)
      CALL ZFROUT(ACCXYZ,3)
      CALL AXEXYZ(I,ACCXYZ)
      CONSV = CONS*(TOHGF - ACCZ/GRAVTY)
      CONSH = CONS*(TOHGH - ACCX/GRAVTY)
      ZHEADR = ZERO
      XHEADR = ZERO
CIEA END
CIEA  HEADR(L,M) = CONS*(CHAS(I)-RELZ)*AVED(I)                    HEAD0290
      ZHEADR = CHAS(I) - RELZ
      XHEADR = ZERO
      IF ( ABS(ZHEADR/CHAS(I)).GT.EPS ) GO TO 3230
      IF ( IWT1(L+MP1) )                3220, 3240, 3210
3210  CONTINUE
      ZHEADR = CHASZ
      GO TO 3240
3220  CONTINUE
      ZHEADR = -CHASZ
      GO TO 3240
3230  CONTINUE
      ZHEADR = CHASZ - RELZZ
3240  CONTINUE
      IF ( VOL3DX(I).NE.ZERO )                 . GO TO 3270
      IF ( IWT1(L+NP1) )                3260, 3280, 3250
3250  CONTINUE
      XHEADR = CHASX
      GO TO 3280
3260  CONTINUE
      XHEADR = -CHASX
      GO TO 3280
3270  CONTINUE
      XHEADR = CHASX - RELZX
3280  CONTINUE
      HEADR(L,M) = AVED(I)*(CONSV*ZHEADR+CONSH*XHEADR)
CIEA  WRITE(6,6881)M,I,HEADR(L,M),CHASZ,RELZZ,ZMZ,ACCZ,ACCX
CIEA *              ,TOHGF,TOHGH,CONSV,CONSH,ZHEADR,XHEADR
6881  FORMAT (2I5,1P6E13.6/10X,6E13.6)
CIEA END
C                                                                 HEAD0306
C          +----------+           +----------+
C          I          I           I          I
C     50 =>I          I      70 =>I          I
C          I--- ZM ---I           I          I
C          I    X     I           I    X     I
C          I          I           I--- ZH ---I
C     ** =>I          I      60 =>I          I
C          I          I           I          I
C          +----------+           +----------+
C
C
CIEA  IF (CHAS(I) .LT. ZM(I)) GO TO 40                            HEAD0315
      IF ( CHASZ .LT. ZMZ )  GO TO 40
CIEA  IF (RELZ .LT. ZM(I)) GO TO 60                               HEAD0320
      IF ( RELZZ .LT. ZMZ )  GO TO 60
CIEA END
CIEA  IF (RELZ .GT. ZM(I)) GO TO 50                               HEAD0335
      IF ( RELZZ .GT..ZMZ ) GO TO 50
CIEA END
C  **                                                             HEAD0346
CIEA  HEADR(L,M) = CONS*((CHAS(I)**2-RELZ**2)*HALF*E(I)/ZM(I) +   HEAD0350
CIEA *  (CHAS(I)-RELZ)*F(I))                                      HEAD0355
      IF ( CHAS(I) .NE. RELZ )                 GO TO 3330
      IF ( IWT1(L+MP1) )                3320, 3340, 3310
3310  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3315
      ZHEADR = E(I)/ZMZ*HALF*CHASZ**2 + F(I)*CHASZ
      GO TO 3340
3315  CONTINUE
      ZHEADR = -E(I)*HALF*(CHASZ**2/ZMZ-ZMZ)
     *         -F(I)*(CHASZ-ZMZ) - (ZMZ-TWO*CHASZ)/VS(I)
      GO TO 3340
3320  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3325
      ZHEADR = E(I)*HALF*(CHASZ**2/ZMZ-ZMZ) +
     *         F(I)*(CHASZ-ZMZ) + (ZMZ-TWO*CHASZ)/VS(I)
      GO TO 3340
3325  CONTINUE
      ZHEADR = -E(I)/ZMZ*HALF*CHASZ**2 - F(I)*CHASZ
      GO TO 3340
3330  CONTINUE
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      ZHEADR = E(I)/ZHZ*HALF*(CHASZ**2 - RELZZ**2) +
     *         (CHASZ - RELZZ)*F(I)
3340  CONTINUE
      IF ( VOL3DX(I).NE.ZERO )               GO TO 3370
      IF ( IWT1(L+MP1) )               3360, 3380, 3350
3350  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3355
      XHEADR = F(I)*CHASX
      GO TO 3380
3355  CONTINUE
      XHEADR = CHASX/VS(I)
      GO TO 3380
3360  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3365
      XHEADR = -CHASX/VS(I)
3365  CONTINUE
      XHEADR = -F(I)*CHASX
      GO TO 3380
3370  CONTINUE
      XHEADR = (E(I)*RELZZ/ZHZ + F(I))*(CHASX - RELZX)
3380  CONTINUE
      HEADR(L,M) = CONSV*ZHEADR+CONSH*XHEADR
CIEA END
CHE50 HEADR(L,M) = CONS*(HALF*E(I)*(CHAS(I)**2/ZH(I)-ZH(I)) + F(I)        HEAD0375
CIEA * *(CHAS(I)-ZH(I)) + (ZH(I)-RELZ)/VS(I))                             HEAD0380
50    CONTINUE
      IF ( CHAS(I) .NE. RELZ )               GO TO 3530
      IF ( IWT1(L+MP1) )               3520, 3540, 3510
3510  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3515
      ZHEADR = E(I)/ZHZ*HALF*CHASZ**2 + F(I)*CHASZ
      GO TO 3540
3515  CONTINUE
      ZHEADR = -E(I)*HALF*(CHASZ**2/ZHZ-ZHZ)
     *         -F(I)*(CHASZ-ZHZ) - (ZHZ-TWO*CHASZ)/VS(I)
      GO TO 3540
3520  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3525
      ZHEADR = E(I)*HALF*(CHASZ**2/ZHZ-ZHZ) +
     *         F(I)*(CHASZ-ZHZ) + (ZHZ-TWO*CHASZ)/VS(I)
      GO TO 3540
3525  CONTINUE
      ZHEADR = -E(I)/ZHZ*HALF*CHASZ**2 - F(I)*CHASZ
      GO TO 3540
3530  CONTINUE
      ZHEADR = E(I)/ZHZ*HALF*(CHASZ**2 - ZHZ**2) +
     *         (CHASZ - ZHZ)*F(I) + (ZHZ-RELZZ)/VS(I)
3540  CONTINUE
      IF ( VOL3DX(I).NE.ZERO )               GO TO 3570
      IF ( IWT1(L+MP1) )               3560, 3580, 3550
3550  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3555
      XHEADR = F(I)*CHASX
      GO TO 3580
3555  CONTINUE
      XHEADR = CHASX/VS(I)
      GO TO 3580
3560  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3565
      XHEADR = -CHASX/VS(I)
3565  CONTINUE
      XHEADR = -F(I)*CHASX
      GO TO 3580
3570  CONTINUE
      XHEADR = (CHASX - RELZX)/VS(I)
3580  CONTINUE
      HEADR(L,M) = CONSV*ZHEADR+CONSH*XHEADR
CIEA END
CHE60 HEADR(L,M) = CONS*((CHAS(I)-ZH(I))/VS(I) + F(I)*(ZH(I)-RELZ)        HEAD0400
CIEA * + HALF*E(I)*(ZH(I)-RELZ**2/ZH(I)))                                 HEAD0405
60    CONTINUE
      IF ( CHAS(I) .NE. RELZ )               GO TO 3630
      IF ( IWT1(L+MP1) )               3620, 3640, 3610
3610  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3615
      ZHEADR = E(I)*HALF*ZHZ + F(I)*ZHZ + (CHASZ-ZHZ)/VS(I)
      GO TO 3640
3615  CONTINUE
      ZHEADR = CHASZ/VS(I)
      GO TO 3640
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3620  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3625
      ZHEADR = -CHASZ/VS(I)
      GO TO 3640
3625  CONTINUE
      ZHEADR = -E(I)*HALF*ZMZ - F(I)*ZMZ - (CHASZ-ZMZ)/VS(I)
      GO TO 3640
3630  CONTINUE
      ZHEADR = E(I)/ZMZ*HALF*(ZMZ**2 - RELZZ**2) +
     *         (ZMZ - RELZZ)*F(I) + (CHASZ-ZMZ)/VS(I)
3640  CONTINUE
      IF ( VOL3DX(I).NE.ZERO )                  GO TO 3670
      IF ( IWT1(L+MP1) )                  3660, 3680, 3650
3650  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3655
      XHEADR = F(I)*CHASX
      GO TO 3680
3655  CONTINUE
      XHEADR = CHASX/VS(I)
      GO TO 3680
3660  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3665
      XHEADR = -CHASX/VS(I)
3665  CONTINUE
      XHEADR = -F(I)*CHASX
      GO TO 3680
3670  CONTINUE
      XHEADR = (E(I)*RELZZ/ZMZ + F(I))*(CHASX - RELZX)
3680  CONTINUE
      HEADR(L,M) = CONSV*ZHEADR+CONSH*XHEADR
CIEA END
CNE70 HEADR(L,M) = CONS*(CHAS(I)-RELZ)/VS(I)                          HEAD0425
70    CONTINUE
      IF ( CHAS(I) .NE. RELZ )                  GO TO 3730
      IF ( IWT1(L+MP1) )                  3720, 3740, 3710
3710  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3715
      ZHEADR = E(I)*HALF*ZMZ + F(I)*ZMZ + (CHASZ-ZMZ)/VS(I)
      GO TO 3740
3715  CONTINUE
      ZHEADR = CHASZ/VS(I)
      GO TO 3740
3720  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3725
      ZHEADR = -CHASZ/VS(I)
      GO TO 3740
3725  CONTINUE
      ZHEADR = -E(I)*HALF*ZMZ - F(I)*ZMZ - (CHASZ-ZMZ)/VS(I)
      GO TO 3740
3730  CONTINUE
      ZHEADR = (CHASZ-RELZZ)/VS(I)
3740  CONTINUE
      IF ( VOL3DX(I).NE.ZERO )                  GO TO 3770
      IF ( IWT1(L+MP1) )                  3760, 3780, 3750
3750  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3755
      XHEADR = F(I)*CHASX
      GO TO 3780
3755  CONTINUE
      XHEADR = CHASX/VS(I)
      GO TO 3780
3760  CONTINUE
      IF ( CHASZ.LT.ZERO )  GO TO 3765
      XHEADR = -CHASX/VS(I)
3765  CONTINUE
      XHEADR = -F(I)*CHASX
      GO TO 3780
3770  CONTINUE
      XHEADR = (CHASX - RELZX)/VS(I)
3780  CONTINUE
      HEADR(L,M) = CONSV*ZHEADR+CONSH*XHEADR
CIEA END
*LOCATE INC1 XX
     *       3HSIN,3HCOS,3HEXP,3HABS,4H     /                         INC10130   ⑦
      DO 240 J = 1,19                                                 INC10845
      GO TO (340,350,350,350,350,350,350,350,350),J2                  INC11005
*LOCATE INJU XX
CIEA  DIMENSION L3B(27)                                               INJU0115
      DIMENSION L3B(27),L3T(8)                                                   ⑧
      DATA L3T / 0,0, 0, 2,0,1,2*0 /
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CIEA END
CIEA  ISIZ06 = 90                                                     INJU0345
      ISIZ06 = 92
      NEWEQS(IDX02) = 0
CIEA END
CIEA  L3B(2) = -L3B(1) - 8                                            INJU0650
      L3B(2) = -L3B(1) - 7
CIEA END
CIEA START                                                            INJU1394
CN134 IF (LRST) GO TO 140                                             INJU1395
  134 CONTINUE
      L3T(1) = 80000 + 10*DLJUNI + 9
      L3T(6) = 1
      CALL INP2 (ISTOR(IDXCRD),IWT1(IDX06),L3T)
      IF (L3T(6) .LE. 0) GO TO 139
      IF (IABS(IWT1(IDX06)).LE.1 .AND. IABS(IWT2(IDX06)).LE.1)
     *                                                  GO TO 139
      WRITE(6,6670)
 6670 FORMAT('0******** ERROR ON THE FOLLOWING CARD.  VALUE FOR IWT1/2',
     *' OUT OF RANGE.   -1 <= VALUE <= 1')
      NOGO = .TRUE.
  139 IF (LRST) GO TO 140
CIEA END
CIEA 2 CONCO(IDX06),ANGLJ(IDX06)                                      INJU1425
     2 CONCO(IDX06),ANGLJ(IDX06),IWT1(IDX06),IWT2(IDX06)
CIEA END
CIEA START                                                            INJU2244
CN380 IC    = -L3B(2)                                                 INJU2245
  380 IC    = -L3B(2) + 1
CIEA END
CIEA 4 ,5X,4(5H INDX),15X,4H(FT),24X,9H(DEGREES)             )        INJU3020
     4 ,5X,4(5H INDX),15X,4H(FT),24X,9H(DEGREES),5X,' IWT1 IWT2')
CIEA END
CN610 FORMAT(1H ,4X,5I5,I6,2X,1P3E14.6)                               INJU3035
  610 FORMAT(1H ,4X,5I5,I6,2X,1P3E14.6,2I5)
CIEA END
¥LOCATE INPU XX
CIEA                                                                  INPU0131
      DIMENSION L3T(9)
CIEA END       END
CIEA  DATA L3 / 010001, -010004, 1, 42, 0, 1, 2, 0, 0 /               INPU0205
      DATA L3 / 010001, -010003, 1, 42, 0, 1, 2, 0, 0 /
C
      DATA L3T /010004,       0, 0, 10, 0, 1, 2, 0, 0 /
CIEA END
CIEA +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++ INPU0736
      ENDFILE  6
CIEA +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
CIEA  ISIZ = ISIZ + 6                                                 INPU0955
      ISIZ = ISIZ + 16
CIEA END
CN145 IF (.NOT.NOGO) RETURN                                           INPU1190
  145 CONTINUE
      IDXPRB = IDXPRB + ISIZ - 10
      CALL INP2 (ISTOR(IDXCRD),ISTOR(IDXPRB),L3T)
      IF (.NOT.NOGO) RETURN
CIEA END
¥LOCATE INRP XX
CIEA  IUP = FILSIZ(2) - 6                                             INRP0150
      IUP = FILSIZ(2) - 16
CIEA END
CIEA  IUP = IUP + 6                                                   INRP0615
      IUP = IUP + 16
CIEA END
¥LOCATE INVO XX
CIEA  DIMENSION L3(22)                                                INVO0130
      DIMENSION L3(22),L3T(9)
CIEA END
CIEA START                                                            INVO0366
      DATA L3T/ 0, 0,  0,  6, 0, 1, 2 ,1 ,1/
CIEA END
CIEA  ISIZ = 99                                                       INVO0435
      ISIZ = 105
      NEWEQS(I2) = 0
CIEA END
CIEA  L3(2) = -L3(1) - 8                                              INVO0705
      L3(2) = -L3(1) - 7
CIEA END
CIEA START                                                            INVO2194
CN400 IF (LRST) GO TO 410                                             INVO2195
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  400 CONTINUE
      L3T(1) = L3(1) + 8
      L3T(6) = 1
      RAD3DX(I5) = 0.0
      RAD3DY(I5) = 0.0
      RAD3DZ(I5) = 0.0
      VOL3DX(I5) = 0.0
      VOL3DY(I5) = 0.0
      VOL3DZ(I5) = 1.0
      CALL INP2 (RSTOR(IDXCRD),RAD3DX(I5),L3T)
C     IF (L3T(6) .LE. 0)  GO TO 409
C      IF (VOL3DZ(I5) .GE. 0.0)  GO TO 409
C     WRITE(6,6670)
C6670 FORMAT('0******** ERROR ON THE FOLLOWING CARD.  VALUE FOR HLNGT',
C    *' OUT OF RANGE.   VALUE >= 0.0')
C     CALL FAIL
  409 IF (LRST) GO TO 410
CIEA END
CIEA * DPDMF(I5)                                                        INV02220
     * DPDMF(I5)
     * ,RAD3DX(I5),RAD3DY(I5),RAD3DZ(I5)
     * ,VOL3DX(I5),VOL3DY(I5),VOL3DZ(I5)
CN410 IC = -L3(2)                                                       INV02225
  410 IC =  L3T(1)
CIEA END
CN770 FORMAT(4X,2I5,6X,1P4E14.6)                                        INV03215
  770 FORMAT(4X,2I5,6X,1P4E14.6/20X,6E14.6)
CIEA END
CIEA *         'RAIN OUT      INTER REGION'/                            INV03340
     *         'RAIN OUT      INTER REGION'/
CIEA END
CIEA *         'VEL.(FT/SEC)  HTC(B/H-F2)')                             INV03350
     *         'VEL.(FT/SEC)  HTC(B/H-F2)')
CIEA END
¥LOCATE JSVE XX
*CALL TOMG                                                              JSVE0186
      READ (5,67700,END=9) TOMFCT                                       JSVE0386
67700 FORMAT (F10.0)
      IF ( TOMFCT.EQ.ZERO )  GO TO 9
      GO TO 10
    9 TOMFCT = ONE
CIEA START                                                              JSVE0406
      GRAVTM = GRAVTY*TOMGF
CIEA END
CIEA  SIGMA  = SIGMA * GRAVTY                                           JSVE0575
      SIGMA  = SIGMA * GRAVTM
CIEA  TERM1  = (RHOL-RHOG) * SIGMA * GRAVTY / (RHOL**2.0)               JSVE0770
      TERM1  = (RHOL-RHOG) * SIGMA * GRAVTM / (RHOL**2.0)
CIEA *     GRAVTY * 144.0 / DX                                          JSVE2170
     *     GRAVTM * 144.0 / DX
CIEA *     GRAVTY * 144.0 / DX                                          JSVE2210
     *     GRAVTM * 144.0 / DX
CIEA  DPDX = (SPVJG(I)-SPVJL(I)) * (P(L)-P(K)) * GRAVTY                 JSVE2245
      DPDX = (SPVJG(I)-SPVJL(I)) * (P(L)-P(K)) * GRAVTM
       SV = AMIN1( SV*TOMFCT,  0.0)                                     JSVE2637
¥LOCATE RTRN XX
CIEA ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++   RTRN0226
      ENDFILE  6
CIEA ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
¥LOCATE STST XX
CIEA                                                                    STST0466
      CALL TOMGFS
CIEA
¥LOCATE TRAN XX
CIEA                                                                    TRAN0676
      CALL TOMGFS
CIEA
CIEA  IF (ICF(LPD).NE.1) GO TO 70                                       TRAN0765
      IF (ICF(LPD).EQ.0) GO TO 70
CIEA
¥LOCATE WATR XX
CIEA  DIMENSION LAG(15), LAG2(8), LAG3(25), LAG4(12)                    WATR0360
      DIMENSION LAG(42), LAG2(8), LAG3(25), LAG4(12)                    WATR0361
CIEA  DATA ONE, TWO, THREE, FOUR / 1.0E0, 2.0E0, 3.0E0, 4.0E0 /         WATR0390
      DATA    ONE,    TWO,    THREE,   FOUR ,    FIVE ,     SIX         WATR0391
     *     / 1.0E0 , 2.0E0 , 3.0E0 , 4.0E0 ,   5.0E0  , 6.0E0 /         WATR0392
CIEA  DATA LAG/ -.4117961750E+01, -.3811294543E-03,  .4308265942E-05,   WATR0415
CIEA A          -.9160120130E-08,  .8017924673E-11, -.4816067020E-05,   WATR0416
CIEA B           .7744786733E-07, -.6988467605E-09,  .1916720525E-11,   WATR0417
CIEA C          -.1760288590E-14, -.1820625039E-08,  .1440785930E-10,   WATR0418
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CIEA D          -.2082170753E-13, -.3603625114E-16,  .7407124321E-19/   WATR0419
C                                                                       WATR0420
C                                                                       WATR0421
      DATA LAG/ -.4134029589E+01, -.2441184054E-04,  .2209870962E-05,   WATR0422
     A          -.6070628894E-08,  .1316350552E-10, -.1522929216E-13,   WATR0423
     B           .8589240994E-17, -.3421502161E-05,  .5157995569E-07,   WATR0424
     C          -.7610491182E-09,  .3333816472E-11, -.6337446779E-14,   WATR0425
     D           .5400840762E-17, -.1866330638E-20, -.2182353803E-08,   WATR0426
     E           .5762274970E-10, -.6869462033E-12,  .3899888586E-14,   WATR0427
     F          -.1073370946E-16,  .1309877667E-19, -.5683523484E-23,   WATR0428
     G           .2259079893E-11, -.6805783575E-13,  .8026765479E-15,   WATR0429
     H          -.4349228692E-17,  .1157103300E-19, -.1389663618E-22,   WATR0430
     I           .5988902843E-26, -.9015092027E-15,  .2792720654E-16,   WATR0431
     J          -.3238260469E-18,  .1726010684E-20, -.4584612622E-23,   WATR0432
     K           .5548851287E-26, -.2422095395E-29,  .1221331859E-18,   WATR0433
     L          -.3818512162E-20,  .4338257722E-22, -.2281516843E-24,   WATR0434
     M           .6066135172E-27, -.7396337791E-30,  .3260076238E-33/   WATR0435
CIEA  SP0 = LAG(1) + H*( LAG(2)  +H*( LAG(3) +H*( LAG(4)  +H* LAG(5) )))WATR1206
CIEA  SP1 = LAG(6) + H*( LAG(7)  +H*( LAG(8) +H*( LAG(9)  +H* LAG(10))))WATR1207
CIEA  SP2 = LAG(11)+ H*( LAG(12) +H*( LAG(13)+H*( LAG(14) +H* LAG(15))))WATR1208
CIEA  ARG = SP0 + P * ( SP1 + P * SP2 )                                 WATR1209
C                                                                       WATR1210
      SP0 = LAG( 1) + H*( LAG( 2) + H*( LAG( 3) + H*( LAG( 4)           WATR1211
     *              + H*( LAG( 5) + H*( LAG( 6) + H * LAG( 7) )))))     WATR1212
      SP1 = LAG( 8) + H*( LAG( 9) + H*( LAG(10) + H*( LAG(11)           WATR1213
     *              + H*( LAG(12) + H*( LAG(13) + H * LAG(14) )))))     WATR1214
      SP2 = LAG(15) + H*( LAG(16) + H*( LAG(17) + H*( LAG(18)           WATR1215
     *              + H*( LAG(19) + H*( LAG(20) + H * LAG(21) )))))     WATR1216
      SP3 = LAG(22) + H*( LAG(23) + H*( LAG(24) + H*( LAG(25)           WATR1217
     *              + H*( LAG(26) + H*( LAG(27) + H * LAG(28) )))))     WATR1218
      SP4 = LAG(29) + H*( LAG(30) + H*( LAG(31) + H*( LAG(32)           WATR1219
     *              + H*( LAG(33) + H*( LAG(34) + H * LAG(35) )))))     WATR1220
      SP5 = LAG(36) + H*( LAG(37) + H*( LAG(38) + H*( LAG(39)           WATR1221
     *              + H*( LAG(40) + H*( LAG(41) + H * LAG(42) )))))     WATR1222
C                                                                       WATR1223
      ARG = SP0 + P*( SP1 + P*(SP2 + P*(SP3 + P*(SP4 + P*SP5 ))))       WATR1224
C                                                                       WATR1225
CIEA  DVDPH = SPVOL * (SP1 + TWO * P * SP2)                             WATR2105
      DVDPH = SPVOL *(SP1 + P*(TWO*SP2 + P*(THREE*SP3 + P*(FOUR*SP4     WATR2106
     *                                 + FIVE*P*SP5 ))))                WATR2107
CIEA  SH1 = LAG(2) + P*( LAG(7)  + P* LAG(12) )                         WATR2180
CIEA  SH2 = LAG(3) + P*( LAG(8)  + P* LAG(13) )                         WATR2181
CIEA  SH3 = LAG(4) + P*( LAG(9)  + P* LAG(14) )                         WATR2182
CIEA  SH4 = LAG(5) + P*( LAG(10) + P* LAG(15) )                         WATR2183
CIEA  DVDHP = SPVOL *(SH1 +H*( TWO*SH2 + H*( THREE*SH3 + H *FOUR*SH4))) WATR2184
C                                                                       WATR2185
      SH1 = LAG( 2) + P*( LAG( 9) + P*(LAG(16) + P*(LAG(23)             WATR2186
     *                            + P*(LAG(30) + P* LAG(37) ))))        WATR2187
      SH2 = LAG( 3) + P*( LAG(10) + P*(LAG(17) + P*(LAG(24)             WATR2188
     *                            + P*(LAG(31) + P* LAG(38) ))))        WATR2189
      SH3 = LAG( 4) + P*( LAG(11) + P*(LAG(18) + P*(LAG(25)             WATR2190
     *                            + P*(LAG(32) + P* LAG(39) ))))        WATR2191
      SH4 = LAG( 5) + P*( LAG(12) + P*(LAG(19) + P*(LAG(26)             WATR2192
     *                            + P*(LAG(33) + P* LAG(40) ))))        WATR2193
      SH5 = LAG( 6) + P*( LAG(13) + P*(LAG(20) + P*(LAG(27)             WATR2194
     *                            + P*(LAG(34) + P* LAG(41) ))))        WATR2195
      SH6 = LAG( 7) + P*( LAG(14) + P*(LAG(21) + P*(LAG(28)             WATR2196
     *                            + P*(LAG(35) + P* LAG(42) ))))        WATR2197
C                                                                       WATR2198
      DVDHP = SPVOL * (SH1 + H*(TWO *SH2 + H*(THREE*SH3 + H*(FOUR*SH4   WATR2199
     *                     + H*(FIVE*SH5 + SIX*H*SH6 )))))              WATR2200
¥LOCATE WAT7 XX
CIEA  P=10.                                                             WAT71260
CIEA  I RECOMENDE A BELOW VALUE FOR UPDATE STEAM TABLE                  WAT71261
C                                                                       WAT71262
      P=1.0                                                             WAT71263
¥LOCATE ENTR XX
      GO TO 20                                                          ENTR0395        ⑭
¥LOCATE HAVG XX
      DIMENSION HWKEEP(4)                                               HAVG0156
      DATA HWKEEP /4*0.0/,HWTOM/0.0/,ITTOM/0/,TOMFCT/0.005/             HAVG0176
C     READ (5,67700) TOMFCT                                             HAVG0241
67700 FORMAT (F10.0)                                                    HAVG0242
      IF ( LINEAR                    )      GO TO 6739                  HAVG1491        ⑮
      IF ( OLVOLN(K).NE.110 .AND. OLVOLN(K).NE.210)  GO TO 6739
      ITTOM = ITTOM + 1
C1    CALL SLIPHW (OLVOLN(K), HWTOM, AX)
C1    IF ( AX.EQ.ZERO )                          GO TO 6739
C1    IF ( ITTOM.GT.10 )                         GO TO 6734
C1    IF ( HWKEEP(OLVOLN(K)/100).EQ.ZERO )  GO TO 6731
```

```
C1     HW(K) = 0.5*(HWKEEP(OLVOLN(K)/100) + HWTOM)
C1     GO TO 6732
C6731 IF ( HWTOM.NE.ZERO ) HW(K) = HWTOM
C6732 CONTINUE
C1     HWKEEP(OLVOLN(K)/100) = HWTOM
CXXX  IF ( ITTOM.GT.200 ) TOMFCT =  0.008
      IF ( HWKEEP(OLVOLN(K)/100).NE.ZERO )            GO TO 6734
CCCC  HWKEEP(OLVOLN(K)/100) = AMIN1(HW(K),500.0)
      HWKEEP(OLVOLN(K)/100) = HW(K)
      GO TO 6738
6734  CONTINUE
      HWKEEP(OLVOLN(K)/100) = HWKEEP(OLVOLN(K)/100) + FU(K)*TOMFCT
      HW(K) =                  HWKEEP(OLVOLN(K)/100)
6738  CONTINUE
C     WRITE (6,67390) OLVOLN(K), HW(K), FU(K), AX
67390 FORMAT (' @@@@',I5,1P3E13.6)
6739  CONTINUE
¥LOCATE SFR  XX
      DATA ZERO / 0.E0/, ONE / 1.E0/, PT95 / 0.95/, PT999 / 0.99999  /  SFR 0220    ⑯
¥INSERT         XX
      SUBROUTINE SLIPHW (NVHW, SLPHW, AX)                                 SLHW0010
*CALL BKCM                                                                SLHW0020
*CALL ID02                                                                SLHW0030
*CALL ID05                                                                SLHW0040
*CALL ID06                                                                SLHW0050
*CALL ID07                                                                SLHW0060
      LOGICAL NTFRST                                                      SLHW0070
                                                                          SLHW0080
C                                                                         SLHW0090
*CALL  UNIT                                                               SLHW0100
      DATA ZERO / 0.0E0 /, ONE / 1.0E0 /, TWO / 2.0E0 /, FOUR / 4.0E0 /   SLHW0110
      DATA NTFRST / .FALSE. /                                             SLHW0120
C                                                                         SLHW0130
      IF (NTFRST) GO TO 5                                                 SLHW0140
      I2      = FILIDX(2)                                                 SLHW0150
      I5      = FILIDX(5)                                                 SLHW0160
      IS5     = SETSIZ(5)                                                 SLHW0170
      MS5     = I5 + (NVOL(I2)-1)*IS5                                     SLHW0180
      I6      = FILIDX(6)                                                 SLHW0190
      I7      = FILIDX(7)                                                 SLHW0200
      IS6     = SETSIZ(6)                                                 SLHW0210
      MS6     = I6 + (NJUN(I2)-1)*IS6                                     SLHW0220
      DO    1 JIN = I6,MS6,IS6                                            SLHW0230
         KK = IW2N(JIN) - 1                                               SLHW0240
         K  = I5 + KK*IS5                                                 SLHW0250    ⑰
         IF ( OLVOLN(K).EQ.110 )   GO TO 5                                SLHW0260
1     CONTINUE                                                            SLHW0270
      STOP 6000                                                           SLHW0280
5     CONTINUE                                                            SLHW0290
C                                                                         SLHW0295
      AX = ZERO                                                           SLHW0300
      DO 101 J = I6,MS6,IS6                                               SLHW0310
         KK = IW1N(J) - 1                                                 SLHW0320
         K  = I5 + KK*IS5                                                 SLHW0330
         IF ( OLVOLN(K).EQ.NVHW )   GO TO 120                             SLHW0340
101   CONTINUE                                                            SLHW0350
      STOP 6001                                                           SLHW0360
120   CONTINUE                                                            SLHW0370
      IF ( NVHW.NE.110 .AND. NVHW.GT.210 ) GO TO 900                      SLHW0380
      IF ( VSLPJ(J).GE.ZERO ) GO TO 900                                   SLHW0390
      QSUM = ZERO                                                         SLHW0400
      DO 141 K = I5,MS5,IS5                                               SLHW0410
         IF ( OLVOLN(K).EQ.NVHW                                           SLHW0420
     *      )  QSUM = QSUM + QSPL(K)                                      SLHW0430
141   CONTINUE                                                            SLHW0440
      TOMTMP = AJUNT(J)*(HPG(J)-HPL(J))                                   SLHW0450
      TOMAA = (WP(J)*(HPG(J)-HP(JIN))-QSUM)*SPVJL(J)/TOMTMP               SLHW0460
      TOMBB = (WP(J)*(HP(JIN)-HPL(J))+QSUM)*SPVJG(J)/TOMTMP               SLHW0470
      TOMTMP = VSLPJ(J) - TOMAA - TOMBB                                   SLHW0480
      AX = (TOMTMP+SQRT(TOMTMP**2+FOUR*VSLPJ(J)*TOMBB))/(TWO*VSLPJ(J))    SLHW0490
      XA = AX*SPVJL(J)/(AX*SPVJL(J)+(ONE-AX)*SPVJG(J))                    SLHW0500
      SLPHW = HPL(J) + XA*(HPG(J)-HPL(J))                                 SLHW0510
900   CONTINUE                                                            SLHW0520
      RETURN                                                              SLHW0530
      END
¥INSERT         XX
      SUBROUTINE TOMGST                                                   TMST0005
     *(MODE,IDXF,IFIL,DD)                                                 TMST0010
*CALL BKCM                                                                TMST0015
*CALL TOMG                                                                TMST0020    ⑱
C                                                                         TMST0025
```

```
      REAL NEXTID, IDXF(1), IFIL(1), DD(5,1)                            TMST0030
      INTEGER COUTX                                                     TMST0035
C                                                                       TMST0040
      DATA IEDT / 1 /, COUTX /4HCOUT/                                   TMST0045
      DATA PI180 / 1.745329252E-2 /                                     TMST0050
C                                                                       TMST0055
      CALL ZEROUT(TOMGH,16)                                             TMST0060
      IZET2D = 0                                                        TMST0061
      CALL ROLAXS                                                       TMST0062
CIEAJ WRITE (6,7120) ((TR(I,J),I=1,3),J=1,3)                            TMST0063
7120  FORMAT (' ****TR ',1P3E13.6/8X,3E13.6)                            TMST0064
      TOMGF = 1.0                                                       TMST0065
      TEMPID = NEXTID(0)                                                TMST0070
      LEN = LCONTG(1)                                                   TMST0075
      CALL RESERV(TEMPID,LEN,2,IDXVAR)                                  TMST0080
      ISTOR(IDXVAR) = COUTX                                             TMST0085
C                                                                       TMST0090
C                                                                       TMST0095
C     FOR VERTICAL FORCE                                                TMST0100
      IF ( ISTOR(FILIDX(2)+28).LT.2 )                     GOTO 100      TMST0105
      ISTOR(IDXVAR+1) =-ISTOR(FILIDX(2)+28)                             TMST0110
      CALL SEARCH (ITOMGF,IDXVAR,IEDT,MODE,IDXF,IFIL,DD,J,K)            TMST0115
  100 CONTINUE                                                          TMST0120
C                                                                       TMST0125
C     FOR HORIZONTAL FORCE                                              TMST0130
      IF ( ISTOR(FILIDX(2)+48).EQ.0 )                     GOTO 120      TMST0135
      ISTOR(IDXVAR+1) = ISTOR(FILIDX(2)+48)                             TMST0140
      CALL SEARCH (ITOMGH,IDXVAR,IEDT,MODE,IDXF,IFIL,DD,J,K)            TMST0145
  120 CONTINUE                                                          TMST0150
C                                                                       TMST0155
C     FOR Z-AXIS ROLLING PHI                                            TMST0160
      IF ( ISTOR(FILIDX(2)+49).EQ.0 )                     GOTO 140      TMST0165
      ISTOR(IDXVAR+1) = ISTOR(FILIDX(2)+49)                             TMST0170
      CALL SEARCH (IPHIZ ,IDXVAR,IEDT,MODE,IDXF,IFIL,DD,J,K)            TMST0175
  140 CONTINUE                                                          TMST0180
C                                                                       TMST0185
C     FOR Z-AXIS ROLLING PHI DOT                                        TMST0190
      IF ( ISTOR(FILIDX(2)+50).EQ.0 )                     GOTO 160      TMST0195
      ISTOR(IDXVAR+1) = ISTOR(FILIDX(2)+50)                             TMST0200
      CALL SEARCH (IPHIZD,IDXVAR,IEDT,MODE,IDXF,IFIL,DD,J,K)            TMST0205
  160 CONTINUE                                                          TMST0210
C                                                                       TMST0215
C     FOR Z-AXIS ROLLING PHI 2DOT                                       TMST0220
      IF ( ISTOR(FILIDX(2)+51).EQ.0 )                     GOTO 180      TMST0225
      ISTOR(IDXVAR+1) = ISTOR(FILIDX(2)+51)                             TMST0230
      CALL SEARCH (IPHI2D,IDXVAR,IEDT,MODE,IDXF,IFIL,DD,J,K)            TMST0235
  180 CONTINUE                                                          TMST0240
C                                                                       TMST0245
C     FOR Y-AXIS ROLLING THETA                                          TMST0250
      IF ( ISTOR(FILIDX(2)+52).EQ.0 )                     GOTO 200      TMST0255
      ISTOR(IDXVAR+1) = ISTOR(FILIDX(2)+52)                             TMST0260
      CALL SEARCH (ITHEY ,IDXVAR,IEDT,MODE,IDXF,IFIL,DD,J,K)            TMST0265
  200 CONTINUE                                                          TMST0270
C                                                                       TMST0275
C     FOR Y-AXIS ROLLING THETA DOT                                      TMST0280
      IF ( ISTOR(FILIDX(2)+53).EQ.0 )                     GOTO 220      TMST0285
      ISTOR(IDXVAR+1) = ISTOR(FILIDX(2)+53)                             TMST0290
      CALL SEARCH (ITHEYD,IDXVAR,IEDT,MODE,IDXF,IFIL,DD,J,K)            TMST0295
  220 CONTINUE                                                          TMST0300
C                                                                       TMST0305
C     FOR Y-AXIS ROLLING THETA 2DOT                                     TMST0310
      IF ( ISTOR(FILIDX(2)+54).EQ.0 )                     GOTO 240      TMST0315
      ISTOR(IDXVAR+1) = ISTOR(FILIDX(2)+54)                             TMST0320
      CALL SEARCH (ITHE2D,IDXVAR,IEDT,MODE,IDXF,IFIL,DD,J,K)            TMST0325
  240 CONTINUE                                                          TMST0330
C                                                                       TMST0335
C     FOR Z-AXIS ROLLING ZETA                                           TMST0340
      IF ( ISTOR(FILIDX(2)+55).EQ.0 )                     GOTO 260      TMST0345
      ISTOR(IDXVAR+1) = ISTOR(FILIDX(2)+55)                             TMST0350
      CALL SEARCH (IZETX ,IDXVAR,IEDT,MODE,IDXF,IFIL,DD,J,K)            TMST0355
  260 CONTINUE                                                          TMST0360
C                                                                       TMST0365
C     FOR Z-AXIS ROLLING ZETA DOT                                       TMST0370
      IF ( ISTOR(FILIDX(2)+56).EQ.0 )                     GOTO 280      TMST0375
      ISTOR(IDXVAR+1) = ISTOR(FILIDX(2)+56)                             TMST0380
      CALL SEARCH (IZETXD,IDXVAR,IEDT,MODE,IDXF,IFIL,DD,J,K)            TMST0385
  280 CONTINUE                                                          TMST0390
C                                                                       TMST0395
C     FOR Z-AXIS ROLLING ZETA 2DOT                                      TMST0400
      IF ( ISTOR(FILIDX(2)+57).EQ.0 )                     GOTO 300      TMST0405
```

```
      ISTOR(IDXVAR+1) = ISTOR(FILIDX(2)+57)
      CALL SEARCH (IZET2D,IDXVAR,IEDT,MODE,IDXF,IFIL,DD,J,K)
  300 CONTINUE
      CALL DELETE(TEMPID)
                                                      GOTO 900
C
      ENTRY  TOMGFS
C
      TOMGF = 1.0
      TOMGH = 0.0
      CALL ZEROUT(PHIZ,9)
      IF ( ISTOR(FILIDX(2)+28).GE. 2 )
     *     TOMGF = FLOATR(RSTOR(ITOMGF))
      IF ( ISTOR(FILIDX(2)+48).NE. 0 )
     *     TOMGH = FLOATR(RSTOR(ITOMGH))
      IF ( ISTOR(FILIDX(2)+49).NE. 0 )
     *     PHIZ  = FLOATR(RSTOR(IPHIZ ))*PI180
      IF ( ISTOR(FILIDX(2)+50).NE. 0 )
     *     PHIZD = FLOATR(RSTOR(IPHIZD))*PI180
      IF ( ISTOR(FILIDX(2)+51).NE. 0 )
     *     PHI2D = FLOATR(RSTOR(IPHI2D))*PI180
      IF ( ISTOR(FILIDX(2)+52).NE. 0 )
     *     THEY  = FLOATR(RSTOR(ITHEY ))*PI180
      IF ( ISTOR(FILIDX(2)+53).NE. 0 )
     *     THEYD = FLOATR(RSTOR(ITHEYD))*PI180
      IF ( ISTOR(FILIDX(2)+54).NE. 0 )
     *     THE2D = FLOATR(RSTOR(ITHE2D))*PI180
      IF ( ISTOR(FILIDX(2)+55).NE. 0 )
     *     ZETX  = FLOATR(RSTOR(IZETX ))*PI180
      IF ( ISTOR(FILIDX(2)+56).NE. 0 )
     *     ZETXD = FLOATR(RSTOR(IZETXD))*PI180
      IF ( ISTOR(FILIDX(2)+57).NE. 0 )
     *     ZET2D = FLOATR(RSTOR(IZET2D))*PI180
      CALL ROLAXS
CIEA  WRITE (6,6881) TOMGF,PHIZ,THEY,ZETX
6881  FORMAT(' TOMGF=',1PE13.6,' PHIZ=',E13.6,' THEY=',E13.6
     *      ,' ZETX=',  E13.6)
  900 RETURN
      END
      SUBROUTINE AXEXYZ(I,ACCXYZ)
*CALL BKCM
*CALL IDOS
*CALL TOMG
      DIMENSION ACCXYZ(3),AXYZ(3)
C
      CALL MATMLT(TR,RAD3DX(I),AXYZ,1)
C
      ACCXYZ(1) = ACCXYZ(1) + AXYZ(1)*PHIZD**2 + AXYZ(2)*PHI2D
      ACCXYZ(2) = ACCXYZ(2) + AXYZ(2)*PHIZD**2 - AXYZ(1)*PHI2D
      ACCXYZ(1) = ACCXYZ(1) + AXYZ(1)*THEYD**2 + AXYZ(3)*THE2D
      ACCXYZ(3) = ACCXYZ(3) + AXYZ(3)*THEYD**2 - AXYZ(1)*THE2D
      ACCXYZ(2) = ACCXYZ(2) + AXYZ(2)*ZETXD**2 - AXYZ(3)*ZET2D
      ACCXYZ(3) = ACCXYZ(3) + AXYZ(3)*ZETXD**2 + AXYZ(2)*ZET2D
      RETURN
      END
      SUBROUTINE ROLAXS
*CALL TOMG
C     PHIZ ...... ROLLING ANGLE FOR Z-AXIS
C     THEY ...... ROLLING ANGLE FOR Y-AXIS
C     ZETX ...... ROLLING ANGLE FOR X-AXIS
      DIMENSION TZ(3,3),TY(3,3),TX(3,3),TT(3,3)
      DATA TZ / 8*0.0, 1.0 /
      DATA TY / 4*0.0, 1.0, 4*0.0 /
      DATA TX / 1.0, 8*0.0 /
C
      TZ(1,1) = COS(PHIZ)
      TZ(2,2) =  TZ(1,1)
      TZ(2,1) = SIN(PHIZ)
      TZ(1,2) = -TZ(2,1)
C
      TY(1,1) = COS(THEY)
      TY(3,3) =  TY(1,1)
      TY(3,1) = SIN(THEY)
      TY(1,3) = -TY(3,1)
C
      TX(2,2) = COS(ZETX)
      TX(3,3) =  TX(2,2)
      TX(2,3) = SIN(ZETX)
      TX(3,2) = -TX(2,3)
C
```

```
      CALL MATMLT(TZ,TY,TT,3)                                          TMST0815
      CALL MATMLT(TT,TX,TR,3)                                          TMST0820
C                                                                      TMST0825
      RETURN                                                           TMST0830
      END                                                              TMST0835
      SUBROUTINE MATMLT(A,B,C,N)                                       TMST0840
      DIMENSION A(3,3),B(3,N),C(3,N)                                   TMST0845
C                                                                      TMST0850
      DO 101 J=1,N                                                     TMST0855
         DO 101 I=1,3                                                  TMST0860
            C(I,J) = 0.0                                               TMST0865   ⑳
            DO 101 K=1,3                                               TMST0870
               C(I,J) = C(I,J) + A(I,K)*B(K,J)                         TMST0875
101   CONTINUE                                                         TMST0880
      RETURN                                                           TMST0885
      END                                                              TMST0890
      SUBROUTINE ROLXYZ(I,R,RXYZ)                                      TMST0895
*CALL BKCM                                                             TMST0900
*CALL IDOS                                                             TMST0905
*CALL TOMG                                                             TMST0910
      DIMENSION RXYZ(3)                                                TMST0915
C                                                                      TMST0920
      CALL MATMLT(TR,VOL3DX(I),RXYZ,1)                                 TMST0925   ⑲
C                                                                      TMST0930
      DO 101 J=1,3                                                     TMST0935
101      RXYZ(J) = RXYZ(J)*R                                           TMST0940
      RETURN                                                           TMST0945
      END                                                              TMST0950
```

A.2 Input specification of RETRAN-02/GRAV

The following input specifications are the input manuals of improved functions of RETRAN-02/GRAV for users. Input data besides the improved functions are the same as the original REATRAN/02.

2.1 Dimension Data Input Card (01004)

These cards identify the control block numbers (negative number) which specify the rotation angles, the angular velocity, the acceleration and the tangential forces. When zero is input or these cards are omitted, the calculation on the rotation is not done. Free format is applied.
Card number 010001 ~ 010003 ia used for the original dimension data card.

W1-I	ITOMGH	Control block number to calculate the horizontal force which is normalized by the gravity acceleration.
W2-I	IPHIZ	Control block number to calculate the rotation angular of degree around z axis. Positive value means the angular from the x axis toward the y axis.
W3-I	IPHIZD	Control block number to calculate the angular velocity by rotation around the z axis, unit of which is degree/second.
W4-I	IPHI2D	Control block number to calculate the angular acceleration by rotation around the z axis, unit of which is degree/second^2.
W5-I	ITHEY	Control block number to calculate the rotation angular of degree around the y axis. Positive value means the angular from the x axis toward the z axis.
W6-I	ITHEYD	Control block number to calculate the angular velocity by rotation around the y axis, unit of which is degree/second.
W7-I	ITHEY2D	Control block number to calculate the angular acceleration by rotation around the y axis, unit of which is degree/second^2.
W8-I	IZETX	Control block number to calculate the rotation angular of degree around the x axis. Positive value means the angular from the x axis toward the z axis.
W9-I	IZETXD	Control block number to calculate the angular velocity by rotation around the x axis, unit of which is degree/second.
W10-I	IZET2D	Control block number to calculate the angular acceleration by rotation around the y axis, unit of which is

degree/second^2.

2.2 Volume Data Input Card (05xxx9)

These cards identify the position of volume center by rectangular co-ordinates from the center of gravity. The z axis means the vertical direction, the y axis means the direction from the bow to the stern of ship and the x axis means the direction from the starboard to the port of ship. When zero is inputted to RAD3DX, RAD3DY and RAD3DZ, the centrifugal and tangential forces become zero. Free format is applied. Card number 05xxx1 ∼ 05xxx8 ia used for the original volume data card.

W1-R	RAD3DX(ft)	Distance from volume center to the center of gravity in x-axis.
W2-R	RAD3DY(ft)	Distance from volume center to the center of gravity in y-axis.
W3-R	RAD3DZ(ft)	Distance from volume center to the center of gravity in z-axis.
W4-R	VOL3DX(-)	Distance from volume center to the center of rotation in x-axis, normalized by ZVOL.
W5-R	VOL3DY(-)	Distance from volume center to the center of rotation in y-axis, normalized by ZVOL.
W6-R	VOL3DZ(-)	To be 1.0

2.3 Junction Data Input Card (08xxx9)

These cards identify the flag to specify the inlet or outlet junctions of the three-domensional volume. In rotation, an elevation of junction will be calculated to be higher than another elevation of junction connected to the same volume. The junction of higher elevation means outlet at the volume (-) and the junction of lower elevation means inlet at the volume.
Free format is applied. Card number 08xxx1 ∼ 08xxx8 ia used for the original junction data card.

W1-I	IWT1	To specify a junction to be outlet(-1) or inlet(+) for ˉ from ˉ volume. The zero of input data does not specify outlet and inlet of the volume.
W2-I	IWT2	To specify junction to be outlet(-1) or inlet(+) for ˉ to ˉ volume. The zero of input data does not specify outlet and inlet of the volume.

A.3 Input sample of the N.S. Mutsu

As a sample, the input data of which noding is the same as one in Fig. 4.1.3 'RETRAN-02/GRAV Computational nodalization for Mutsu analysis'.

```
 =   MUTSU : (A0011 <FEED WATER CONTROL>)
*************************************************************************
********                                                         ********
*******              < 1990.10.11 ===== IEAJ>                     *******
******     CORE - SEPARATE 3                                       ******
******     S.G.     3 VOLUME                                       ******
******     PRZ      2 VOLUME                                       ******
*******    2 LOOP                                                 *******
********   BASE DATA = CASE11('90)                               ********
*********                                                       *********
*************************************************************************
*
*          PROBLEM DESCRIPTION DATA CARDS
*
*        D   E N  T  V  B T  J P  C  N  F  S G M C H T N M L T I C  S P T D I
*        M   D T  R  O  U D  U M  K  L  I  L O A O T M D W V D S H  S R R N C
*        P   1 C  P  L  B V  N P  V  K  L  B M T R X H L R C V F T  T Z S B F
 010001 -1 16 1 61 41 11 1 60 2 13 21 16 11 2 3 3 2 0 3 1 0 0 2 0  0 1 1 1 1
*        N S S  X S T V F F E S
*        A V C  P T S O I L Q E
*        P L D  L K H I T A S P
 010002 1 0 0  1 0 0 0 0 0 0 0
*          IROLLT   IROLLD  ITOMGH  IROLLDO
 010004      -000      000      000      000   * NULL TRAN.
*      ITOMGH IPHIZ IPHIZD IPHI2D ITHEY ITHEYD ITHE2D IZETX IZETXD IZET2D
 010004 -000  -000   -000   -000  -000   -000   -000  -000   -000   -000
*
 010005  25.0  * MW POWER (70%)
*
*          TAPE  NO.
010140 'MUTSU.CASE15'         *
010141 '1E1435'  'GE'         *
*
*          MINOR EDIT VARIABLES
*
020000 WP**, 160 PRES, 160 PRES, 170  STVG,  101 STVF, 101 AJNT, 160      *
020000 COUT, -13 PRES,  31 LIQL, 101  WP**,  151 WP**, 153 PRES, 101      *
020001 POWR,   0 TEMP,   10 TEMP,   19 WP**, 106 HP**, 151 HP**, 251
020002 COUT, -73 WP**, 112  COUT, -134 AVEX, 110
*
*          TIME STEP DATA CARDS
*
*         NMIN NMAJ NDMP NCHK   DELTM  DTMIN  TLAST
 030010    10  250    1    0    0.2    0.0   10000.      *
*
*          TRIP CONTROL DATA CARDS
*
*         IDTRP IDSIG  IX1  IX2  SETPOINT   DELAY
 040010     1     1     0    0     779.       0.     *END TRIP SIGNAL
 040020     2     1     0    0      0.        0.     *GENERAL TIME ZERO
 040030     3     4    32    0   1792.20      0.     *PRZER RELIEF VALVE OPEN
 040040    -3    -4    32    0   1749.54      0.     *PRZER RELIEF VALVE CLOSE
 040050     4     1     0    0      5.0      1.E9    *DUMMY
 040060     5     2     0    0      4.26      0.     *HIGH POWER
 040070     6    14   -44    0      1.-9      0.     *LOW PRESS. CONTROL SYSTEM
 040080     7    14   -31    0      1.-9      0.     *HIGH TEMP. CONTROL SYSTEM
 040090     8    14   -13    0      7.116     0.     *PRZER HIGH LIQ.L
 040100     9   -14  -286    0      7.044     0.     *SG LOW LIQ.L
 040110    10    14   -13    0      7.116     0.     *PRZER LOW LIQ.L
 040120    11    -4    20    0   1152.1       0.     *HOT LEG LOW PRESS.
 040130    12    13    10   11      0.        0.     *SI SIGNAL
 040140    13    12     5    6      0.        0.     *IDTRIP 5 OR 6
 040150    14    12    13    7      0.        0.     *IDTRIP 13 OR 7
 040160    15    12    14    8      0.        0.     *IDTRIP 14 OR 8
 040170    16    12    15    9      0.        0.     *SCRAM SIGNAL
 040180    17    12    16    0      0.        9.     *FW STOP 9 SEC AFTER SCRAM
 040190    18    12    12   16      0.        0.     *SI OR IDTRIP16 (SCRAM)
 040200    19    12    16    0      0.       15.     *15 SEC AFTER SCRAM
 040210    20    -4    31    0   1507.8       0.     *LOW PRESS. BACK.HEATER ON
 040220   -20     4    31    0   1550.46      0.     *LOW PRESS. BACK.HEATER OFF
 040230    21    14   -13    0      1.235     0.     *V. HEATER INTERLOCK ON-0.0
 040240   -21   -14   -13    0      1.235     0.     *V. HEATER INTERLOCK OFF+0.0
 040250    22    14   -73    0      5.0       0.     * #2 ROD IN START
 040260   -22   -14   -73    0      4.7       0.     * #2 ROD IN STOP
 040270    23    14   -73    0      1.2       0.     * #1 ROD IN START
 040280   -23   -14   -73    0      1.1       0.     * #1 ROD IN STOP
 040290    24   -14   -73    0     -1.2       0.     * #1 ROD OUT START
 040300   -24    14   -73    0     -1.1       0.     * #1 ROD OUT STOP
 040310    25   -14   -73    0     -5.0       0.     * #2 ROD OUT START
 040320   -25    14   -73    0     -4.7       0.     * #2 ROD OUT STOP
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040330   26   14   -13   0    6.508    0.    *60% LEVEL BACK.HEATER
040340  -26  -14   -13   0    6.508    0.    *60% LEVEL BACK.HEATER
040350    1   12    18   0    0.      1.+9   *DUMMY
040360   30   12    12  16    0.      0.7    *0.7 SEC AFTER SCRAM(CON.ROD)
040370  130    1     0   0    1.+9     0.    *DUMMY
040380  130    1     0   0    1.+9     0.    *DUMMY
040390  140    4   160   0  991.84     0.    *ST-LINE SAFE.VAL OPEN/CLOSE
040400  150   12    16   0    0.      9.0    *STOP VALVE CLOSE AFTER SCRAM
*
049010 -901    5   103   0   10.5      0.    *VOL 103 LEVEL CAL.
049020  901   -6   101   0    0.1      0.    *
049030  902    1     0   0    1.+9     0.    *DUMMY
049040  902    1     0   0    1.+9     0.    *DUMMY
049050 -903    5   203   0   10.5      0.    *VOL 203 LEVEL CAL.
049060  903   -6   201   0    0.1      0.    *
049070  904    1     0   0    1.+9     0.    *DUMMY
049080  904    1     0   0    1.+9     0.    *DUMMY
049090 -905    5   110   0   10.0      0.    *VOL 110 LEVEL CAL.
049100  905   -6   101   0    0.1      0.    *
049110 -906    5   210   0   10.0      0.    *VOL 210 LEVEL CAL.
049120  906   -6   201   0    0.1      0.    *
049130  151    1     0   0    1.+9     0.    *DUMMY
049140  152   12    12   0    0.      20.    *HPIS#1 START 20 SEC AFTER SI
049150  153   12    12   0    0.      30.    *HPIS#2 START 30 SEC AFTER SI
049160  154   12    12   0    0.     600.    *MSIV(A) CLOSE 600SEC AFTER SI
049170  155    1     0   0    1.+9     0.    *HPIS STOP(MANUAL)
049180  156    1     0   0    1.+9     0.    *AFW(A) START(MANUAL)
049190  157   12    12   0    0.    1200.    *AFW(B) START(MANUAL)
049200  158   12    12   0    0.    1200.    *DUMP VALVE OPEN(MANUAL)
049210  500   -2     0   0    0.1      0.    *INTERLOCK FOR DUMP VALVE
*
*         VOLUME DATA CARDS
*
*       IB IR  PRESS   TORH    X      V       ZVOL     ZM
050011   0  0    0.      0.    0.   41.690    4.212    4.212  *LOWER PLENUM
050021   0  0    0.    508.0   0.   12.233    4.433    4.433  *GUIDE TUBE
050031   0  0    0.      0.    0.    6.877    1.081    1.081  *AVE CORE (BOT)
050041   0  0    0.      0.    0.    7.951    1.250    1.250  *AVE CORE (MID)
050051   0  0    0.      0.    0.    6.877    1.081    1.081  *AVE CORE (TOP)
050061   0  0    0.      0.    0.   24.065    4.342    4.342  *CORE BYPASS
050071   0  0    0.      0.    0.   96.9372   6.138    6.138  *U.P.+ANNULUS
050081   0  0    0.      0.    0.   35.840    2.661    2.661  *UPPER HEAD
050091   0  0    0.      0.    0.   52.865   11.238   11.238  *DOWN COMER
050101   0  0    0.      0.    0.    7.539   11.983   11.983  *HOT LEG 1
050111   0  0    0.      0.    0.    5.120    2.690    2.690  *SG 1 INLET
050121   0  0    0.      0.    0.    3.826    4.232    4.232  *U-TUBE
050131   0  0    0.      0.    0.    4.794    5.719    5.719  *U-TUBE
050141   0  0    0.      0.    0.    4.794    5.719    5.719  *U-TUBE
050151   0  0    0.      0.    0.    3.826    4.232    4.232  *U-TUBE
050161   0  0    0.      0.    0.    6.264    2.690    2.690  *SG 1 OUTLET
050171   0  0    0.      0.    0.    3.823    5.645    5.645  *CROSS OVER LEG
050181   0  0    0.      0.    0.    7.062    2.368    2.368  *PUMP 1
050191   0  0    0.      0.    0.    6.144    7.783    7.783  *COLD LEG 1
050201   0  0 1579.6     0.    0.    7.539   11.983   11.983  *HOT LEG 2
050211   0  0    0.      0.    0.    5.120    2.690    2.690  *SG 2 INLET
050221   0  0    0.      0.    0.    3.826    4.232    4.232  *U-TUBE
050231   0  0    0.      0.    0.    4.794    5.719    5.719  *U-TUBE
050241   0  0    0.      0.    0.    4.794    5.719    5.719  *U-TUBE
050251   0  0    0.      0.    0.    3.826    4.232    4.232  *U-TUBE
050261   0  0    0.      0.    0.    6.264    2.690    2.690  *SG 2 OUTLET
050271   0  0    0.      0.    0.    3.823    5.645    5.645  *CROSS OVER LEG
050281   0  0    0.      0.    0.    7.062    2.368    2.368  *PUMP 2
050291   0  0    0.      0.    0.    6.144    7.783    7.783  *COLD LEG 2
050301   0  0    0.    621.4   0.    0.528    4.371    4.371  *SURGE LINE
050311   0  0    0.    621.4   0.   37.468    3.8      3.8    *PRESSURIZER
050321   1  0    0.      0.    0.   54.338    5.511    0.47   *PRESSURIZER
*
051011   3  0   654.7    0.    0.   54.010    4.402    0.460   * SG 1 DOME
051031   4  0    0.      0.    0.   34.618   10.711   10.711   *SG 1 DC
051101   6  0    0.      0.    0.   56.849   15.0     15.0     *SG 1 RISER
051501   0  0    0.      0.    0.    2.623    2.834    2.834   * ST-LINE NO1
*
052011   8  0   654.7    0.    0.   54.010    4.402    0.460   * SG 1 DOME
052031   9  0    0.      0.    0.   34.618   10.711   10.711   *SG 2 DC
052101  11  0    0.      0.    0.   56.849   15.0     15.0     *SG 2 RISER
052501   0  0    0.      0.    0.    2.623    2.834    2.834   * ST-LINE NO2
*
051601   0  0    0.      0.    0.   39.213    4.488    4.488   *MAIN STEAM LINE
*
*        FLOWL    FLOWA    DIAMV    ELEV    INQ VRN VLC FB NES
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050012   0.     7.375   3.064  -12.054              *LOWER PLENUM
050022   0.     2.551   0.3186 -10.703   0    0.    0. 11      *GUIDE TUBE
050032   0.     6.3618  0.0465  -6.27               *AVE CORE (BOT)
050042   0.     6.3618  0.0465  -5.189              *AVE CORE (MID)
050052   0.     6.3618  0.0465  -3.939              *AVE CORE (TOP)
050062   0.     5.695   2.693   -6.569              *CORE BYPASS
050072   0.     9.027   3.390   -2.858              *U.P.+ ANNULUS
050082   0.     9.509   3.481    3.280              *UPPER HEAD
050092   0.     5.715   2.698   -7.842   0    0.    0. 12      *DOWN COMER
050102   0.     0.349   0.666  -11.650   0    0.    0. 13      *HOT LEG 1
050112   0.     2.010   1.510   -8.799              *SG 1 INLET
050122   0.     0.900   1.070   -6.109              *U-TUBE
050132   0.     0.900   1.070   -1.877              *U-TUBE
050142   0.     0.900   1.070   -1.877              *U-TUBE
050152   0.     0.900   1.070   -6.109              *U-TUBE
050162   0.     2.528   1.794   -8.799              *SG 1 OUTLET
050172   0.     0.349   0.666  -11.665   0    0.    0.  7      *CROSS OVER LEG
050182   0.     0.349   0.666   -6.020              *PUMP 1
050192   0.     0.349   0.666   -7.450   0    0.    0. 11      *COLD LEG 1
050202   0.     0.349   0.666  -11.650   0    0.    0. 13      *HOT LEG 2
050212   0.     2.010   1.510   -8.799              *SG 2 INLET
050222   0.     0.900   1.070   -6.109              *U-TUBE
050232   0.     0.900   1.070   -1.877              *U-TUBE
050242   0.     0.900   1.070   -1.877              *U-TUBE
050252   0.     0.900   1.070   -6.109              *U-TUBE
050262   0.     2.528   1.794   -8.799              *SG 2 OUTLET
050272   0.     0.349   0.666  -11.665   0    0.    0.  7      *CROSS OVER LEG
050282   0.     0.349   0.666   -6.020              *PUMP 2
050292   0.     0.349   0.666   -7.450   0    0.    0. 11      *COLD LEG 2
050302   0.     0.028   0.188   -8.989              *SURGE LINE
050312   0.     9.586   3.543   -4.818   0    0.    0. 20      *PRESSURIZER
050322   0.     9.586   3.543   -1.018   1    4.    5000.      *PRESSURIZER
*
051012   0.    12.271    0.       4.740                    * SG 1 DOME
051032   0.     1.302    0.      -5.971                    *SG 1 DOWNCOMER
051102   0.     2.024    0.      -5.971                    *SG 1 RISER
051502   0.    0.1402   0.4226    8.225                    * ST-LINE NO1
*
052012   0.    12.271    0.       4.740                    * SG 2 DOME
052032   0.     1.302    0.      -5.971                    *SG 2 DOWNCOMER
052102   0.     2.024    0.      -5.971                    *SG 2 RISER
052502   0     0.1402   0.4226    8.225                    * ST-LINE NO2
*
051602   0.    0.2736   0.5902 6.655                *MAIN STEAM LINE
*
*         RAD3DX    RAD3DY    RAD3DZ   VOL3DX   VOL3DY   VOL3DZ
050019   0.         0.       -13.065   0.       0.       1.
050029   0.         0.       -11.604   0.       0.       1.
050039   0.         0.        -8.847   0.       0.       1.
050049   0.         0.        -7.681   0.       0.       1.
050059   0.         0.        -6.516   0.       0.       1.
050069   0.         0.        -7.515   0.       0.       1.
050079   0.         0.        -2.906   0.       0.       1.
050089   0.         0.         1.494   0.       0.       1.
050099   0.         0.        -5.340   0.       0.       1.
050109   6.7957    6.7957     -8.776   3.899   -6.144    1.
050119   2.8315   10.6183    -10.571   0.       0.       1.
050129   2.8315   10.6183     -7.110   0.       0.       1.
050139   2.8315   10.6183     -2.135   0.       0.       1.
050149   2.8315   10.6183     -2.135   0.       0.       1.
050159   2.8315   10.6183     -7.110   0.       0.       1.
050169   2.8315   10.6183    -10.571   0.       0.       1.
050179   0.0      10.6183    -11.960   0.       0.       1.
050189  -3.5394   10.6183     -7.953   0.       0.       1.
050199  -6.7957    6.7957     -6.676  -4.730  -10.551    1.
050209  -6.7957   -6.7957     -8.776  -3.899    6.144    1.
050219  -2.8315  -10.6183    -10.571   0.       0.       1.
050229  -2.8315  -10.6183     -7.110   0.       0.       1.
050239  -2.8315  -10.6183     -2.135   0.       0.       1.
050249  -2.8315  -10.6183     -2.135   0.       0.       1.
050259  -2.8315  -10.6183     -7.110   0.       0.       1.
050269  -2.8315  -10.6183    -10.571   0.       0.       1.
050279   0.0     -10.6183    -11.960   0.       0.       1.
050289   3.5394  -10.6183     -7.953   0.       0.       1.
050299   6.7957   -6.7957     -6.676   4.730   10.551    1.
050309  12.7419    -.8495     -9.921   0.       0.       1.
050319  12.7419    -.8495     -6.035   0.       0.       1.
050329  12.7419    -.8495     -1.379   0.       0.       1.
051019   2.8315   10.6183      3.825   0.       0.       1.
051039   2.8315   10.6183     -3.733   0.       0.       1.
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051109   2.8315  10.6183   -3.487  0.      0.      1.
051509   2.8315  10.6183    6.525  0.      0.      1.
052019  -2.8315 -10.6183    3.825  0.      0.      1.
052039  -2.8315 -10.6183   -3.733  0.      0.      1.
052109  -2.8315 -10.6183   -3.487  0.      0.      1.
052509  -2.8315 -10.6183    6.525  0.      0.      1.
051609  -2.8315 -10.6183    5.782  0.      0.      1.
*
*           BUBBLE DATA CARDS
*           ALPH  VBUB   A-ID    V-ID
060011   0.8    3.0                         *PZR
060021   0.8    3.0                         *NOT USE
060031   0.8    1.E6                        *SG 1 SEP.
060041   0.0    3.0   -277    -276          *SG 1 D.C.
060051   0.0    3.0                         *DUMMY
060061   0.0    3.0   -277    -279          *SG 1 RISER
060071   0.8    0.0                         *NOT USE
060081   0.8    1.E6                        *SG 2 SEP.
060091   0.0    3.0   -277    -278          *SG 2D.C.
060101   0.0    3.0                         *DUMMY
060111   0.0    3.0   -277    -280          *SG 2 RISER
*
*           TIME DEPENDENT VOLUME
*              TIME    PRES    TEMP   QUA     MIXL        P
070101   7    0.0      0.0    495.7   1.      50.     * 654.7
070102       30.0      0.0    495.7   1.      50.     * 654.7
070103      167.0      0.0    494.2   1.      50.     * 646.2
070104      263.0      0.0    494.2   1.      50.     * 646.2
070105      323.0      0.0    495.4   1.      50.     * 653.3
070106      375.0      0.0    496.2   1.      50.     * 657.6
070107      420.0      0.0    496.2   1.      50.     * 657.6
*
*
*           JUNCTION DATA CARD
*
*        IW1 IW2 IP VAL    WP     AJUN    ZJUN    INERT   FJUNF  FJUNR
080011    1   2  0  0     0.     2.551 -10.703   1.323   1.610  0.      *
080021    2   3  0  0 1212.9     6.365  -6.270   0.8953 19.477  0.      *
080031    3   4  0  0     0.     6.365  -5.189   0.1832  1.685  0.      *
080041    4   5  0  0     0.     6.365  -3.939   0.1832  1.730  0.      *
080051    5   7  0  0     0.     6.365  -2.858   0.692  -1.     0.      *
080061    2   6  0  0     0.     0.184  -6.569  24.48   21.425  0.      *
080071    6   7  0  0     0.     1.196  -2.227   3.520  -1.     0.      *
080081    7   8  0  0     0.     0.424   3.280   0.525  12.338 12.844  *
080091    9   1  0  0     0.     3.972  -7.842   2.167   5.829  0.      *
080101    7  10  0  0   628.3    0.349   0.     31.25    1.104  0.      *
080111   10  11  0  0   628.3    0.349  -8.562  34.59    0.7078 0.      *
080121   11  12  0  0     0.     0.900  -6.109   2.985   1.533  0.      *
080131   12  13  0  0     0.     0.900  -1.877   5.321   1.191  0.      *
080141   13  14  0  0     0.     0.900   3.202   5.919   3.583  0.      *
080151   14  15  0  0     0.     0.900  -1.877   5.321   1.200  0.      *
080161   15  16  0  0     0.     0.900  -6.109   2.852   0.059  0.      *
080171   16  17  0  0     0.     0.349  -8.566  19.28    0.4121 0.      *
080181   17  18 -2  0     0.     0.349  -6.020   0.      0.415  0.      *
080191   18  19  2  0     0.     0.349  -3.986   0.      0.684  0.      *
080201   19   9  0  0     0.     0.349   0.     25.316  -1.     0.      *
080211    7  20  0  0   628.3    0.349   0.     31.25    1.104  0.      *
080221   20  21  0  0     0.0    0.349  -8.562  34.59    0.7078 0.      *
080231   21  22  0  0     0.     0.900  -6.109   2.685   1.533  0.      *
080241   22  23  0  0     0.     0.900  -1.877   5.321   1.191  0.      *
080251   23  24  0  0     0.     0.900   3.202   5.919   3.583  0.      *
080261   24  25  0  0     0.     0.900  -1.877   5.321   1.200  0.      *
080271   25  26  0  0     0.     0.900  -6.109   2.852   0.059  0.      *
080281   26  27  0  0     0.     0.349  -8.566  19.28    0.4121 0.      *
080291   27  28 -1  0     0.     0.349  -6.020   0.      0.4154 0.      *
080301   28  29  1  0     0.     0.349  -3.986   0.      0.1684 0.      *
080311   29   9  0  0     0.     0.349   0.     25.316   1.567  0.      *
080321   10  30  0  0     0.     0.028  -8.989 772.47    1.547  2.487  *
080331   30  31  0  0     0.     0.028  -4.618 500.61    1.547  2.487  *
080341    0  32  1  1     0.     1.      4.493   1.      1.     0.      *SPRAY
080351    0  29  2  1     0.     1.     -2.944   1.      1.     0.      *NEG.SPRAY
080361   31  32  0  0     0.     9.586  -1.018   0.      0.     0.      *
*
081061 103 110  0  0   0.      5.296  -5.970   3.882  20.0   19.5   *SG1 DCM-RSR
081121  110  101  0 0 154.7    1.249  9.029  1.374   -1. 43.67 *SG1 SEP-DM
081011 101 103  0  0 141.8      1.302  4.74     2.361   4.2    3.7   *SG1 DM-DCM
*
081511   0 103  7  2 12.9     1.       4.740   1.       1.     1.     *FW1
081521 101 150  0  0 12.9     0.2804  8.225  0.  0.5   1.  *
081531 150 160  0  10 12.9     0.1402 10.848   0.       5.834  1.+9  *
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*
 082061 203 210  0  0    0.      5.296  -5.970   3.882  20.0   19.5   *SG1 DCM-RSR
082121  210  201  0 0 154.7     1.249  9.029  1.374   -1.  43.67*SG2 SEP-DM
 082011 201 203  0  0 141.8      1.302  4.74     2.361   4.2    3.7   *SG2 DM-DCM
*
 082511   0 203  8  2 12.9      1.       4.740   1.       1.      1.     *FW2
082521 201 250  0   0 12.9     0.2804  8.225  0.  0.5   1.  *
 082531 250 160  0   0 12.9      0.1402 10.848   0.      -1.      1.+9  *
*
 081601   0 160 16  0      0.     1.       6.777   0.       0.      0. *TURBINE VALVE
 081611   0 160  9  0      0.     1.      10.847   0.5      1.0     0.     *DUMP VALVE
 081621   0 160  3  9      0.     1.      10.847   0.5      1.0     0.     *SV 1
 081631   0 160  4  9      0.     1.      10.847   0.5      1.0     0.     *SV 2
 080561   0  32  5  3      0.     1.       4.493   1.       1.      1.     *PORV
 080571   0  32  6  4      0.     1.       4.493   1.       1.      1.     *PZR SV
*
 080911   0    9 10  5     0.     1.       0.      0.       0.      0.     *HPIS#1
 080921   0    9 11  6     0.     1.       0.      0.       0.      0.     *HPIS#2
*
*
 081541   0 103 12 11      0.     1.       4.740   0.       0.      0.     *AFW(A)
 082541   0 203 13 12      0.     1.       4.740   0.       0.      0.     *AFW(B)
*
 081641   0 160 14 13      0.     1.      10.847   0.       0.      0. *DUMP(MANUAL)
 083001   0  17 15  0      0.     1.     -11.665   0.       0.      0. *C.P.+LET-DOWN
*
*         JV   JC   JCA   MV   DIAMJ   CONC FRJ TPMJ ANGL IHC
 080012   0   -1    0     0    0.       1.  -99  0     0.   0    *
 080022   0   -1    0     0    0.       1.  -99  0     0.   2    *
 080032   0   -1    0     0    0.       1.  -99  0     0.   3    *
 080042   0   -1    0     0    0.       1.  -99  0     0.   3    *
 080052   0   -1    0     0    0.       1.  -99  0     0.   1    *
 080062   0   -1    0     0    0.       1.  -99  0     0.   0    *
 080072   0   -1    0     0    0.       1.  -99  0     0.   0    *
 080082   0   -1    0     0    0.       1.  -99  0     0.   0    *
 080092   0   -1    0     0    0.       1.  -99  0     0.   0    *
 080102   1   -1    0     0    0.       1.  -99  0     0.   0    *
 080112   0   -1    0     0    0.       1.  -99  0     0.   0    *
 080122   0   -1    0     0    0.       1.  -99  0     0.   2    *
 080132   0   -1    0     0    0.       1.  -99  0     0.   3    *
 080142   1   -1    0     0    0.       1.  -99  0     0.   3    *
 080152   0   -1    0     0    0.       1.  -99  0     0.   3    *
 080162   0   -1    0     0    0.       1.  -99  0     0.   1    *
 080172   0   -1    0     0    0.       1.  -99  0     0.   0    *
 080182   0   -1    2     0    0.       1.  -99  0     0.   0    *
 080192   0   -1    2     0    0.       1.  -99  0     0.   0    *
 080202   1   -1    0     0    0.       1.  -99  0     0.   0    *
 080212   1   -1    0     0    0.       1.  -99  0     0.   0    *
 080222   0   -1    0     0    0.       1.  -99  0     0.   0    *
 080232   0   -1    0     0    0.       1.  -99  0     0.   2    *
 080242   0   -1    0     0    0.       1.  -99  0     0.   3    *
 080252   1   -1    0     0    0.       1.  -99  0     0.   3    *
 080262   0   -1    0     0    0.       1.  -99  0     0.   3    *
 080272   0   -1    0     0    0.       1.  -99  0     0.   1    *
 080282   0   -1    0     0    0.       1.  -99  0     0.   0    *
 080292   0   -1    2     0    0.       1.  -99  0     0.   0    *
 080302   0   -1    2     0    0.       1.  -99  0     0.   0    *
 080312   1   -1    0     0    0.       1.  -99  0     0.   0    *
 080322   0   -1    0     3    0.       1.  -99  0     0.   0    *
 080332   0   -1    0     0    0.       1.  -99  0     0.   0    *
 080362   1   -1    2     0    0.       1.  -99  0     0.   0    *
 080342   0   -1    0     0    0.       1.  -99  0     0.   0    *
 080352   0   -1    0     0    0.       1.  -99  0     0.   0    *
*
 081122   0    0    0     0    0.       1.    2  1     0.   1    *SG1 SPRTR-DOME
 081012   0    0    2     0    0.       1.  -99  0     0.   0    *SG1 DOME-DCMR
 081062   1    0    0     0    0.       1.  -99  2     0.   2    *SG1 DCMR-RISER
*
 081512   0   -1    0     0    1.       1.  -99  0     0.   0    *
 081522   0    0    2     0    0.       1.  -99  0     0.   0    *
 081532   0    0    2     0    0.       1.  -99  0     0.   0    *
*
 082122   0    0    0     0    0.       1.    2  1     0.   1    *SG2 SPRTR-DOME
 082012   0    0    2     0    0.       1.  -99  0     0.   0    *SG2 DOME-DCMR
 082062   1    0    0     0    0.       1.  -99  2     0.   2    *SG2 DCMR-RISER
*
 082512   0   -1    0     0    1.       1.  -99  0     0.   0    *
 082522   0    0    2     0    0.       1.  -99  0     0.   0    *
 082532   0    0    2     0    0.       1.  -99  0     0.   0    *
*
```

```
081602   0   0   0    0   0.     1.  -99  0    0.   0   *
081612   0   0   0    0   0.     1.  -99  0    0.   0   *
081622   0   0   0    0   0.     1.  -99  0    0.   0   *
081632   0   0   0    0   0.     1.  -99  0    0.   0   *
080562   0   0   0    0   0.     1.  -99  0    0.   0   *
080572   0   0   0    0   0.     1.  -99  0    0.   0   *
*
080912   0  -1   0    0   0.     1.  -99  0    0.   0   *
080922   0  -1   0    0   0.     1.  -99  0    0.   0   *
*
081542   1  -1   0    0   0.     1.  -99  0    0.   0   *AFW(A)
082542   1  -1   0    0   0.     1.  -99  0    0.   0   *AFW(B)
*
081642   1   0   0    0   0.     1.  -99  0    0.   0   *DUMP(MANUAL)
*
083002   0   0   0    0   0.     1.  -99  0    0.   0   *C.P+LET DOWN
*
*       IWT1 IWT2
080019   0   0
080029   0   0
080039   0   0
080049   0   0
080059   0   0
080069   0   0
080079   0   0
080089   0   0
080099   0   0
080109   0  +1
080119  -1   0
080129   0   0
080139   0   0
080149   0   0
080159   0   0
080169   0   0
080179   0   0
080189   0   0
080199   0  -1
080209  +1   0
080219   0  -1
080229  +1   0
080239   0   0
080249   0   0
080259   0   0
080269   0   0
080279   0   0
080289   0   0
080299   0   0
080309   0  -1
080319  +1   0
080329   0   0
080339   0   0
080349   0   0
080359   0   0
080369   0   0
081019   0   0
081069   0   0
081129   0   0
081519   0   0
081529   0   0
081539   0   0
082019   0   0
082069   0   0
082129   0   0
082519   0   0
082529   0   0
082539   0   0
081609   0   0
081619   0   0
081629   0   0
081639   0   0
080569   0   0
080579   0   0
080919   0   0
080929   0   0
081549   0   0
082549   0   0
081649   0   0
083009   0   0
*
*         PUMP DESCRIPTION DATA CARDS
```

```
*
*         IP  TRIP RP PM  MT  POMGAR PRAT PFLOWR  PHEADR  PTORKR PINRTA
090011  1   12   1  1   0  1770.  1.  5848.00  170.    477.52 159.17  *PUMP 2
090021  1   12   1  1   0  1770.  1.  5848.00  170.    477.52 159.17  *PUMP 1
*
*         VRHOI  TRKMR TORKF1  TORKF2 TORKF3 TORKF4
090012   48.257  0.     0.0     20.0  477.56   0.0   *
090022   48.257  0.     0.0     20.0  477.56   0.0   *
*
*         PUMP HEAD MULTIPLIER
*
091010  -11  0.00 .00  0.10 .00  0.15 .05  0.24 .80  0.30 .96  0.40 .98  *
091011       0.60 .97  0.80 .90  0.90 .80  0.96 .50  1.00 .00            *
*
*         PUMP TORQUE MULTIPLIER
*
092010   -2    0.  0.   1.  0.   *
*
*         PUMP CURVE SET INPUT DATA CARDS
*
*         NPC    NC(J)
100000    0      16       *
*
*         PUMP HEAD & TORQUE DATA CARDS
*
101011    6    0.0 1.52   0.2 1.49   0.4 1.42   0.6 1.32   0.8 1.19   1.0 1.00
101021    6    0.0 -.81   0.2 -.55   0.4 -.27   0.6 0.00   0.8 0.48   1.0 1.00
101031    6   -1.0 2.95  -0.8 2.55  -0.6 2.09  -0.4 1.79  -0.2 1.60   0.0 1.52
101041    6   -1.0 2 95  -0.8 2.44  -0.6 1.94  -0.4 1.61  -0.2 1.33   0.0 1.14
101051    6    0.0 -.16   0.28 0.0   0.4 0.09   0.6 0.31   0.8 0.50   1.0 0.74
101061    6    0.0 1.14   0.2 0.97   0.4 0.84   0.6 0.75   0.8 0.72   1.0 0.74
101071    2   -1.0 0.00   0.0 0.00
101081    2   -1.0 0.00   0.0 0.00
101091    6    0.0 0.83   0.2 0.87   0.4 0.92   0.6 0.95   0.8 0.96   1.0 1.00
101101    6    0.0 -.67   0.2 -.38   0.3 -.22   0.4 -.04   .425 0.0   1.0 1.00
101111    6   -1.0 2.04  -0.8 1.60   0.6 1.24  -0.4 1.00  -0.2 0.88   0.0 0.83
101121    6   -1.0 2.04  -0.8 1.81  -0.6 1.67  -0.4 1.57  -0.2 1.38   0.0 1.21
101131    7    0.0 -1.0   .25 -0.6   0.4 -.37   0.5 -.25   0.6 -.16   0.8 0.00
101132         1.0 0.26
101141    6    0.0 1.21   0.2 1.04   0.4 0.85   0.6 0.63   0.8 0.44   1.0 0.26
101151    2   -1.0 0.00   0.0 0.00
101161    2   -1.0 0.00   0.0 0.00
*
*         VALVE DATA CARDS
*
*         ITCV IACV V2 PCV   CV1  CV2  CV3
110010    -2     0  0   0.   0.   0.   0.   *PRZER SPRAY VALVE
110020    17     0  0   0.   0.   0.   0.   *SG FEED WATER (J151,251)
110030    -2     0  0   0.   0.   0.   0.   *PRZER REL. VAL. (J56)
110040    -2     0  0   0.   0.   0.   0.   *PRZER SAF. VAL. (J57)
110050   155     0  0   0.   0.   0.   0.   *HPIS#1 STOP VALVE
110060   155     0  0   0.   0.   0.   0.   *HPIS#2 STOP VALVE
110070  1000  -247  0   0.   0.   0.   0.   *TURBINE CONTROL (J160)
110080    -4     0  0   0.   0.   0.   0.   *NOT USE
110090  -140     0  0   0.   0.   0.   0.   *ST-LINE SAF.VAL (J162,163)
110100   154    14  0   0.   0.   0.   0.   *MSIV(A)
110110  -156     0  0   0.   0.   0.   0.   *AFW(A) VALVE
110120  -157     0  0   0.   0.   0.   0.   *AFW(B) VALVE
110130  -158     0  0   0.   0.   0.   0.   *DUMP VALVE(MANUAL)
*
*         GENERAL DATA TABLE
*
120100   -4   0.0 0.  1572.12 0.  1643.23 1.  1.+9 1.         *SPRAY OPEN RATE
* TABLE WAS SHIFTED,FOR INITIAL SPRAY FLOW IS ZERO
120100   -4   0.0 0.  1579.0  0.  1650.11 1.  1.+9 1.         *SPRAY OPEN RATE
120200   -2  32.0 0.  41. 5.                        *CONV. FR FTEMP TO CTEMP
120300   -4   0.0 0.  1977.06 0.  2015.92 4.344  1.+9 4.344   *PZR SV FLOW
120400   -2   0.0 0.0  1.0 0.0                                *DUMMY
120500  -12   0.0 0.0  0.1 1.0  0.2 1.4  0.3 2.0  0.4 3.0     *PRZER C-V VAL.
120501        0.5 4.8  0.6 8.0  0.7 14.  0.8 20.  0.9 24.
120502        1.0 26.8  1.+9 26.8
120600  -10   0.0 1770.0   0.1 1623.21 0.2 1488.83 0.3 1365.56 *PUMP RPM TABLE
120601        0.4 1252.18  0.5 1147.2  0.6 1049.31 0.7  957.55
120602        0.78 885.0   1.+9 885.0
120700    6   0. 0. 20. 1.7 40. 4.2 60. 8.3 80. 20.1 100. 44.9 *FW.VALVE V-LIFT
120800   -4  -1.+9 3.2  3.20582 3.20582  216.72087 216.72087   *FWP.COMP.SIG.
120801        1.+9 216.72087
120900   -4  -1.0 0.  0.5 0.  0.6 1.  5.0 1.                  *TRIP SIG. DELAY
121000   -2   0.0 0.0 1.0 0.0                                 *DUMMY
121100   -3  -1.0 1.  0.0 0.  1.0 -1.                         *M/T GOV.VALVE
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121200   -2    0.0 0.0 1.0 0.0                                            *DUMMY
121300   -2      0. 21.40  1.+9 21.40                                      *DUMP FLOW
121400   -3      0.  1.      30.  0.    1000.  0. *MSIV(A) TIME VS. AREA
*  FOR GRAVITY CHANGE
121500   -2    0.0 0.0  1.E6 0.0
*  FOR PRZ LIQUID LEVEL CONT.
121600   -4    0.0 55.0  20.0  55.0  80.0  43.6  100.0  43.6 * S/F VS LREF
121700   -6  0. 0. 20. 0.1 40. 0.16 60. 0.24 80. 0.38 100. 0.59 *CV1
121800   -6  0. 0. 20. .13 40. 0.21 60. 0.31 80. 0.48 100. 1.03 *CV2
*
*  TABLE 19 FOR LREF CHANGE
*  TABLE 20 FOR TAVE CHANGE
*
*  STEAM FLOW(KG/H) VS MAIN VALVE LIFT(MM)
122100   25      0.  0.0   11900. 4.46  13200. 5.54  13900. 6.61
122101      14500.  9.57  20500. 11.7  21600. 12.8  22100. 14.0
122102      22400.  16.4  27500. 18.5  28600. 19.5  29100. 20.8
122103      29400.  24.2  34000. 26.6  34900. 27.6  35400. 28.8
122104      35700.  32.1  41100. 35.4  41800. 36.3  42200. 37.5
122105      42300.  40.4  47800. 44.2  48600. 45.5  48900. 46.8
122106      49100.  52.9
*
*        FILL TABLE DATA
*
130100   0 1000    -6   0 -9.       -8.                    *SPRAY INTO PRZER
130200   1 1000    -7   0  0.        0.         0.     0.  *SPRAY FROM COLDLEG
130300  -4    2  1  0    100.        0.     1100.  1000.  *STEAM LINE NO.1
130301                   991.84      0.     1100.  1000.  * SAFETY VALVE
130302                  1010.33  -18.1393  1100.  1000.  * (J162)
130303                  2000.    -18.1393  1100.  1000.  * (LB/FT2,P-FUNC)
130400  -4    2  1  0    100.        0.     1100.  1000.  *STEAM LINE NO.2
130401                   991.84      0.     1100.  1000.  * SAFETY VALVE
130402                  1010.33  -18.1393  1100.  1000.  *  (J163)
130403                  2000.    -18.1393  1100.  1000.  *  (LB/FT2,P-FUNC)
130500   1 1000   -10   0  0.        0.         0.     0.  *PRZER RELIEF VALVE
130600   1 1000   -11   0  0.        0.         0.     0.  *PRZER SAFETY VALVE
130700   1 1000  -165   0  0.        0.      274.0   690.  *SG 2 FEED WATER
130800   1 1000  -225   0  0.        0.      274.0   690.  *SG 1 FEED WATER
130900  -4   16  0  0       0.     -4.9125 1100.  1000.  *DUMP FLOW
130901                      9.     -4.9125 1100.  1000.  *  (LB/FT2.S,P-FUNC)
130902                      9.01     0.     1100.  1000.  *  (LB/FT2.S,P-FUNC)
130903                   5000.       0.     1100.  1000.  *  (LB/FT2.S,P-FUNC)
131000  -14   152 1  1      0.0      198.1     63.05    15.0  * HPIS#1
131001                     14.7      198.1     63.05    15.0  *
131002                    325.7      176.1     63.05    15.0
131003                    537.6      158.5     63.05    15.0
131004                    714.0      140.9     63.05    15.0
131005                    876.1      123.3     63.05    15.0
131006                   1004.1      105.7     63.05    15.0
131007                   1116.5       88.1     63.05    15.0
131008                   1194.7       70.4     63.05    15.0
131009                   1258.7       52.8     63.05    15.0
131010                   1301.4       35.2     63.05    15.0
131011                   1328.4       17.6     63.05    15.0
131012                   1349.7        0.0     63.05    15.0
131013                     1.+9        0.0     63.05    15.0
131100  -14   153 1  1      0.0      198.1     63.05    15.0  * HPIS#2
131101                     14.7      198.1     63.05    15.0  *
131102                    325.7      176.1     63.05    15.0
131103                    537.6      158.5     63.05    15.0
131104                    714.0      140.9     63.05    15.0
131105                    876.1      123.3     63.05    15.0
131106                   1004.1      105.7     63.05    15.0
131107                   1116.5       88.1     63.05    15.0
131108                   1194.7       70.4     63.05    15.0
131109                   1258.7       52.8     63.05    15.0
131110                   1301.4       35.2     63.05    15.0
131111                   1328.4       17.6     63.05    15.0
131112                   1349.7        0.0     63.05    15.0
131113                     1.+9        0.0     63.05    15.0
131200   2     2  0   1     0.0       26.4    217.9    650.0 *AFW(A)
131201                     1.+9       26.4    217.9    650.0 *
131300   2     2  0   1     0.0       26.4    217.9    650.0 *AFW(B)
131301                     1.+9       26.4    217.9    650.0 *
131400   2     2  0   0     0.0     -3.675      1.0      1.0 *DUMP(MANUAL)
131401                     1.+9     -3.675      1.0      1.0 *
131500   0 1000   -317  0   111.   112.     * C.P.F + LET-DOWN FLOW
*
131600  -2    2  0  0       0.     -26.4    1.0  1.0 *TOTAL STEAM FLOW
131601                    1.E6     -26.4    1.0  1.0
```

```
*
*        KINETICS CONSTANTS DATA CARDS
*
 140000  0.0    398.84  0.        1.     *
*
*        DELAYED NEUTRON DATA OVERRIDE CARDS
*
 140001  0.0124      0.0305     0.111      0.301     1.13     3.00 *
 140002  0.030       0.209      0.191      0.395     0.129    0.046 *
*
*        REACTIVITY COEFFICIENT DATA CARDS
*
 140010  0.2329      0.2329     -3.7504-4      -1.0504-2          *
 140020  0.5342      0.5342     -8.6023-4      -2.4092-2          *
 140030  0.2329      0.2329     -3.7504-4      -1.0504-2          *
*
*        SCRAM TABLE DATA CARDS
*
 141100  -9  18    *
 141101  0.0     0.0    0.7    0.0     0.8     -1.021    0.9     -2.836  *
 141102  1.1    -8.733  1.2  -11.796   1.4    -15.652    1.7    -17.581  *
 141103  2.0   -17.581
*
*        ROD CONTROL
*
 141201  -82 1000    0.    0.     *
*
*        DENSITY REACTIVITY TABLE
*
 142001    0    *
*
*        DOPPLER TABLE DATA CARDS
*
 143001    0    *
*
*        HEAT CONDUCTOR DATA CARDS
*
*      IVSL IVSR IGOM CELEV IMCL IMCR   ASUL    ASUR   VOLS     HDML
 150011   0    3    1  .5405   0    2    0.     420.23  3.631    0.      *
 150021   0    4    1  .6250   0    2    0.     486.06  4.201    0.      *
 150031   0    5    1  .5405   0    2    0.     420.23  3.631    0.      *
 150041  12  110    2 2.116    2    2  312.315 312.315 1.4345   0.0531 *
 150051  13  110    2 2.8595   2    2  391.465 391.465 1.798    0.0531 *
 150061  15  110    2 2.116    2    2  312.315 312.315 1.4345   0.0531 *
 150071  14  110    2 2.8595   2    2  391.465 391.465 1.798    0.0531 *
 150081  22  210    2 2.116    2    2  312.315 312.315 1.4345   0.0531 *
 150091  23  210    2 2.8595   2    2  391.465 391.465 1.798    0.0531 *
 150101  25  210    2 2.116    2    2  312.315 312.315 1.4345   0.0531 *
 150111  24  210    2 2.8595   2    2  391.465 391.465 1.798    0.0531 *
*
*        HDMR       DHEL DHER  CHNL     CHNR IHXQF
 150012  0.054714    0.   0.   0.       3.412      *
 150022  0.054714    0.   0.   0.       3.412      *
 150032  0.054714    0.   0.   0.       3.412      *
 150042  0.0863      0.   0.   9.578    9.578   1  *
 150052  0.0863      0.   0.   9.578    9.578   1  *
 150062  0.0863      0.   0.   9.578    9.578   1  *
 150072  0.0863      0.   0.   9.578    9.578   1  *
 150082  0.0863      0.   0.   9.578    9.578   2  *
 150092  0.0863      0.   0.   9.578    9.578   2  *
 150102  0.0863      0.   0.   9.578    9.578   2  *
 150112  0.0863      0.   0.   9.578    9.578   2  *
*
*        CORE SECTION DATA CARDS
*
*       ISLB     CLTI       QRAC
 160010   1     .001312     .2329       *
 160020   2     .001312     .5342       *
 160030   3     .001312     .2329       *
*
*        CONDUCTOR GEOMETRY DATA CARDS
*
*       IG    NR      IM   NDX      XO       XR          PF
 170101   2    3        1   15      0.      0.015762     1.0    *
 170102              1  2    1              0.000199     0.0    *
 170103              0  3    4              0.001312     0.0    *
 170201   2    1        3    4    .02657   0.004593     0.0    *
*
*        THERMAL CONDUCTIVITY OF UO2
*
```

```
180100  -15  200.  3.9      400.  3.35     600.  3.00     800.   2.65  *
180101       1000.  2.35    1200.  2.10    1500.  1.85    1800.   1.65  *
180102       2000.  1.55    2500.  1.30    3000.  1.25    3500.   1.35  *
180103       4000.  1.50    4500.  1.85    5000.  2.45                  *
*
*         THERMAL CONDUCTIVITY OF NANYARONE
*
180200   -2  500.  0.0358        1000.  0.0358  *
*
*         THERMAL CONDUCTIVITY OF SUS
*
180300  -15   80.6  7.494  260.6  8.430  440.6  9.360  620.6  10.295 *
180301        800.6 11.232  980.6 12.168 1160.6 13.098 1340.6  14.034 *
180302       1520.6 14.970 1700.6 15.902 1880.6 16.837 2060.6  17.773 *
180303       2240.6 18.709 2420.6 19.645 2600.6 20.575                *
*
*         VOLUMETRIC HEAT CAPACITY OF UO2
*
190100  -15    32.  34.45     122.  38.35     212.  40.95     392.  43.55 *
190101        752.  46.80    2012.  51.35    2732.  52.65    3092.  56.55 *
190102       3452.  63.05    3812.  72.80    4352.  89.70    4532.  94.25 *
190103       4892. 100.10    5144. 101.40    8000. 101.40                 *
*
*         VOLUMETRIC HEAT CAPACITY OF STEAM
*
190200   -3  600.    0.54     1000.  0.46     1500.  0.45    *
*
*         VOLUMETRIC HEAT CAPACITY OF SUS
*
190300   -7   80.33  60.053   440.33  62.637   800.33  65.134  *
190301       1160.33  67.431  1520.33  69.565  1880.33  71.593  *
190302       2600.6   75.035 *
*
*         LINEAR EXPANSION COEFFICIENTS OF UO2
*
200100    -2       0.  3.718E-6    5000.  1.2653E-6   *
*
*         LINEAR EXPANSION COEFFICIENTS OF STEAM
*
200200    -2       0.  0.           5000.  0.           *
*
*         LINEAR EXPANSION COEFFICIENTS OF SUS
*
200300    -3   440.33 8.46E-6   1520.33 10.47E-6    2600.6 12.772E-6 *
*
*         NON CONDUCTING HEAT EXCHANGER DATA
*
*       IHTX  ITHTXQ  JVOL IHTYPE  TIME  N-POEWR
210101   -61   1000    32    7      0.    0.         *HEATER
210201   -60   1000    32    7      0.    0.         *BACK-UP HEATER
*
*         STEADY-STATE
*
230000      100   0.     7.E-6    0.    *
230000      100   0.     4.E-5    0.    *
230011        1   151    152      0.5   *
230021        2   251    252      0.5   *
*
*
*         CONTROL SYSTEM PROBLEM DIMENIONS DATA CARDS
*
701000        115      308    *
*
*
*         CONTROL INPUT DEFINITION DATA CARDS
702001     1  'PRES'   32        1.      1563.59     *PRZER PRESS
702002     2  'PRES'   29        1.      1593.48     *COLDLEG-1 PRESS
702003     3  'AVED'   29        1.        48.3974   *COLDLEG-1 AVED
702004     4  'PRES'   19        1.      1589.28     *COLDLEG-1 PRESS
702005     5  'HW**'   29        1.       508.965    *COLDLEG-1 SPEC.ENTHL
702006     6  'TRIP'    3        1.         0.       *TRIP FLAG BL3
702007     7  'CONS'    0        3.06       3.06     *PRZER REL.VAL FLOW
702008     8  'PRES'  101        1.       683.2      *RELIEF VALVE SETPOINT
702009     9  'PRES'  201        1.       683.2      *
702010    10  'TEMP'    3        1.       523.977    *
702011    11  'TEMP'    4        1.       532.927    *
702012    12  'TEMP'    5        1.       541.733    *
702013    13  'TEMP'   10        1.       529.571    *HOT LEG-1 TEMP
702014    14  'TEMP'   19        1.       518.057    *COLD LEG-1 TEMP
702015    15  'CONS'    0        1.         1.       *CONS. 1.0
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702016	16	'CONS'	0	75.0	75.0	*IN HI.TEMP SCRAM
702017	17	'CONS'	0	305.	305.	*
702018	18	'CONS'	0	0.5	0.5	*PUMP SLOWDWON AFT SCRAM
702019	19	'TRIP'	19	1.	0.	*
702020	20	'TRIP'	20	1.	0.	*
702021	21	'TRIP'	20	1.	0.	*
702022	22	'CONS'	0	8.05	8.05	*POWER REF (KW)
702023	23	'CONS'	0	16.1	16.1	*
702024	24	'CONS'	0	0.	0.	*
702025	25	'CONS'	0	1578.00	1578.00	*PRESS REF(PSI)
702026	26	'WP**'	153	1.	10.7	*STLNE-1 MASS FLOW RATE
702027	27	'WP**'	151	1.	10.7	*FEED-1 MASS FLOW RATE
702028	28	'WP**'	253	1.	10.7	*STLINE-2 MASS FLOW RATE
702029	29	'WP**'	251	1.	10.7	*FEED-2 MASS FLOW RATE
702030	30	'LIQL'	101	1.	0.46	*S.G.1 2ND STEAM MODEL
702031	31	'LIQL'	201	1.	0.46	*S.G.2 2ND STEAM MODEL
702032	32	'LIQL'	103	1.	10.711	*S.G.1 UPPER D/D
702033	33	'LIQL'	203	1.	10.711	*S.G.2 UPPER D/D
702034	34	'PPOW'	0	1.0	1.	*PROMPT POWER FRACTION
702035	35	'WP**'	160	.026677	-0.2433	*STLINE-1 FLOW (WS)
702036	36	'WP**'	160	-1.	9.4	*STLINE-2 FLOW (WS)
702037	37	'TRIP'	22	1.	0.	*#2 ROD IN
702038	38	'TRIP'	23	1.	0.	*#1 ROD OUT
702039	39	'TRIP'	24	1.	0.	*#1 ROD IN
702040	40	'TRIP'	25	1.	0.	*#2 ROD OUT
702041	41	'TRIP'	21	1.	0.	*
702042	42	'TRIP'	30	1.	0.	*
702043	43	'POWR'	0	-0.027778	0.2433	*
702044	44	'H012'	10	1.	523.038	*HOTLEG MESH NO. 12
702045	45	'HW**'	10	1.	523.038	*
702046	46	'H001'	19	1.	508.965	*COLDLEG MESH NO.1
702047	47	'CONS'	0	10.	10.	*
702048	48	'TRIP'	26	1.	0.	*
702049	49	'AJNT'	160	1.	0.15048	*J160 TDV AREA
702050	50	'TRIP'	18	1.	0.	*SCRAM SIG.1 FOR M/T
702051	51	'TRIP'	150	1.	0.	*SCRAM SIG.2 FOR M/T
702052	52	'TRIP'	130	1.	0.	*DUMP VALVE ACTUATE SIG.
702053	53	'TIMX'	0	1.	0.	*
702054	54	'CONS'	0	0.	0.	*DUMMY
702055	55	'CONS'	0	0.	0.	*DUMMY
702056	56	'CONS'	0	0.	0.	*DUMMY
702057	57	'CONS'	0	0.	0.	*DUMMY
702058	58	'CONS'	0	0.	0.	*DUMMY
702059	59	'CONS'	0	0.	0.	*DUMMY
702060	60	'CONS'	0	0.	0.	*DUMMY
702061	61	'TRIP'	901	3.	0.	*VBUB SG 1 D.C.
702062	62	'CONS'	0	0.	0.	*DUMMY
702063	63	'CONS'	0	0.	0.	*ALPHA FOR SG
702064	64	'TRIP'	903	3.	0.	*VBUB SG 2 D.C.
702065	65	'CONS'	0	0.	0.	*DUMMY
702066	66	'TRIP'	905	3.	0.	*VBUB SG 1 RISER
702067	67	'TRIP'	906	3.	0.	*VBUB SG 2 RISER
702068	68	'TRIP'	16	1.	0.	*SCRAM SIGNAL
702069	69	'CONS'	0	0.	0.	*DUMMY
702070	70	'MIXL'	101	1.	0.594	*SG(A) DOME MIX.LEVEL
702071	71	'MIXL'	201	1.	0.594	*SG(B) DOME MIX.LEVEL
702072	72	'MIXL'	103	1.	10.711	*SG(A) D.C. MIX.LEVEL
702073	73	'MIXL'	203	1.	10.711	*SG(B) D.C. MIX.LEVEL
702074	74	'CORQ'	1	1.	2.862+7	*COND. 1 HEAT GEN. RATIO
702075	75	'CORQ'	2	1.	6.564+7	*COND. 2 HEAT GEN. RATIO
702076	76	'CORQ'	3	1.	2.862+7	*COND. 3 HEAT GEN. RATIO
702077	77	'WQCR'	4	1.	1.792+7	*COND. 4 HEAT REM. RATIO
702078	78	'WQCR'	5	1.	1.868+7	*COND. 5 HEAT REM. RATIO
702079	79	'WQCR'	6	1.	1.006+7	*COND. 6 HEAT REM. RATIO
702080	80	'WQCR'	7	1.	1.519+7	*COND. 7 HEAT REM. RATIO
702081	81	'WQCR'	8	1.	1.792+7	*COND. 8 HEAT REM. RATIO
702082	82	'WQCR'	9	1.	1.868+7	*COND. 9 HEAT REM. RATIO
702083	83	'WQCR'	10	1.	1.006+7	*COND.10 HEAT REM. RATIO
702084	84	'WQCR'	11	1.	1.519+7	*COND.11 HEAT REM. RATIO
702085	85	'CONS'	0	1.2288+8	1.2288+8	*INITIAL HEAT GEN. RATIO
702086	86	'CONS'	0	6.185+7	6.185+7	*INITIAL SG(A) HEAT REM. RATIO
702087	87	'CONS'	0	6.185+7	6.185+7	*INITIAL SG(B) HEAT REM. RATIO
702088	88	'WP**'	161	1.	0.0	*S.L. DUMP VALVE FLOW
702089	89	'WP**'	162	1.	0.0	*S.L. SAFETY VALVE#1 FLOW
702090	90	'WP**'	163	1.	0.0	*S.L. SAFETY VALVE#2 FLOW
702091	91	'WP**'	56	1.	0.0	*PZR PORV FLOW
702092	92	'WP**'	57	1.	0.0	*PZR SV FLOW
702093	93	'CONS'	0	0.	0.0	*
702094	94	'CONS'	0	15.0	15.0	* TAU
702095	95	'CONS'	0	3.14159	3.14159	* PAI

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702096     96  'CONS'    0      6.28318    6.28318      * 2*PAI
702097     97  'CONS'    0     39.47835   39.47835      * 4*PAI**2
702098     98  'CONS'    0     .0174533   .0174533      * PAI/180
702099     99  'CONS'    0    0.4189     0.4189     * 2PAI/TG  TG = 15.
702100    100  'STVG'  101      1.          0.674583
702101    101  'STVF'  101      1.          2.04382-2
702102    102  'CONS'    0     61.3784   61.3784
702103    103  'CONS'    0      4.265      4.265
702104    104  'STVG'  201      1.          0.674583
702105    105  'STVF'  201      1.          2.04382-2
702106    106  'CONS'    0      3.581      3.581
702107    107  'TRPT'   16      1.          0.    * FOR TURBINE TRIP
702108    108  'TRIP'  500      1.          0.    * INTERLOCK FOR DUMP VALVE
702109    109  'LIQL'   31      1.0       4.49  * PRZ(2) LIQUID LEVEL
702110    110  'CONS'    0   -0.1690   -0.1690  * PRZ ZERO LEVEL
702111    111  'HW**'   17      1.0      508.801* C.O.L. ENTHALPY
702112    112  'PRES'   17      1.0     1546.08* C.O.L. PRES.
702113    113  'TEMP'   20      1.0           0. * LOOP2 THOT
702114    114  'TEMP'   29      1.0           0. * LOOP2 TCOLD
702115    115  'LIQL'   32      1.0       4.49  * PRZ(1) LIQUID LEVEL
*
*
*              PRZER SPRAY CONTROL
*
*        IDC TYPE   IN1  IN2   G     P1    P2       IC
703001    -1 'FNG'    1    1   1.    0.    0.        0.     *SPRAY VALVE   STROKE
703002    -2 'FNG'   -1    5   1.    0.    0.        0.     *FLOW COEFF.(  C-V)
703003    -3 'SUM'    2    1   1.    1.   -1.       -0.     *DIF.PRESS.(P  19-P31)
703004    -4 'MUL'   -3    3   1.    0.    0.       -0.    0. 1.+75 *DEN19 DIF.PRESS.
703005    -5 'XPO'   -4   18   1.    0.    0.       -0.     *WQRT(DEN19*D  P)
703006    -6 'MUL'   -2   -5 0.0176 0.     0.        0.     *SPRAY MASS FLUX
703007    -7 'MUL'   -6   15  -1.    0.    0.        0.     *NEGATIVE SPRAY FLUX
703008    -8 'MUL'    2   15   1.    0.    0.       -0.     *P19
703009    -9 'MUL'    5   15   1.    0.    0.       -0.     *H19
*
*             PRZER SAFETY VALVE AND RELIEF VALVE MASS FLUX
*        IDC TYPE   IN1  IN2   G      P1       P2       IC
703010   -10 'MUL'    6    7  -1.     0.       0.        0.     *RELIEF VALVE
703011   -11 'FNG'    1    3  -1.     0.       0.        0.     *SAFETY VALVE
703012   -12 'MUL'   15   15   0.     0.       0.        0.     *DUMMY
*
*
703013   -13 'SUM'  109  115   1.     1.       1.        0.     *PRZ LIQL
*
*           HIGH TEMPERATURE SCRAM LOGIC
*        IDC TYPE   IN1  IN2   G      P1       P2       IC
703014   -14 'SUM'   44   45   0.7764 1.      -1.        0.     *
703015   -15 'SUM'  -14   13   1.     1.       1.       -0.     *H.L TEMP. AT DETEC
703016   -16 'SUM'   46    5   0.8251 1.      -1.        0.     *
703017   -17 'SUM'  -16   14   1.     1.       1.       -0.     *C.L TEMP. AT DETEC
703018   -18 'MUL'   15   15   0.     0.       0.        0.     *DUMMY = 0.0
703019   -19 'MUL'   15   15   0.     0.       0.        0.     *DUMMY = 0.0
703020   -20 'FNG'  -15    2   1.     0.       0.       -0.     *H.L TEMP(C)
703021   -21 'FNG'  -17    2   1.     0.       0.       -0.     *C.L TEMP(C)
703022   -22 'LAG'  -20    0   1.     1.8      0.      278.148 *
703023   -23 'DER'  -22    0   2.     0.       0.        0.     *
703024   -24 'LAG'  -23    0   7.4    2.       0.        0.     *
703025   -25 'SUM'  -24  -22   1.     1.       1.       -0.     *
703026   -26 'LAG'  -21    0   1.     1.7      0.      269.585 *
703027   -27 'SUM'  -26   15   1.     1.      15.       -0.     *
703028   -28 'SUM'  -25  -27 -10.5    1.      -1.       -0.     *
703029   -29 'SUM'  -28   15   1.     1.     279.7      -0.     *
703030   -30 'MIN'  -29   17   1.     1.       0.       -0.     *
703031   -31 'SUM'  -30  -26   1.    -1.       1.       -0.     *H.T TRIP
*
*           LOW PRESSURE SCRAM LOGIC
*        IDC TYPE   IN1  IN2   G      P1       P2       IC
703032   -32 'DER'  -20    0   2.     0.       0.        0.     *
703033   -33 'LAG'  -32    0   7.4    2.       0.        0.     *
703034   -34 'SUM'  -33  -20   1.     1.       1.       -0.     *
703035   -35 'LAG'  -34    0   1.     1.8      0.      278.148 *
703036   -36 'LAG'  -21    0   1.     1.7      0.      269.585 *
703037   -37 'SUM'  -35  -36   1.     1.      -1.       -0.     *
703038   -38 'SUM'  -37   15   2.25   1.       5.       -0.     *
703039   -39 'SUM'  -36   15   1.26   1.   -235.        -0.     *
703040   -40 'SUM'  -39   15   1.     1.       0.5      -0.     * 90/10/31
703041   -41 'SUM'  -38  -40   1.     1.       1.       -0.     *
703042   -42 'MAX'  -41   16   1.     0.       0.       -0.     *
703043   -43 'SUM'  -42   15   1.     1.       1.       -0.     *
703044   -44 'SUM'  -43    1   1.     1.  -0.07032      -0.     *L.P TRIP
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*
*         PUMP SPEED CONTROL
*
 703045  -45 'INT'   19    0   1.      0.      0.       0.      *
 703046  -46 'FNG'  -45    6   1.      0.      0.    1770.      *
 703047  -47 'MUL'   15   15   0.      0.      0.       0.      *
 703048  -48 'MUL'   15   15   0.      0.      0.       0.      *
*
*         P'ZER HEATER CONTROL
*
*        IDC TYPE   IN1  IN2   G       P1      P2       IC
 703049  -49 'SUM'    1   25   1.      1.     -1.       0.      *DELTA-P
 703050  -50 'DER'  -49    0   0.1667  0.      0.       0.      *
 703051  -51 'INT'  -49    0   1200.   0.      0.       0.      *
 703052  -52 'SUM'  -49  -50   1.      1.      1.       0.      *
 703053  -53 'SUM'  -52  -51 -2.264-3  1.      1.       0.      *K=-20PCT/K*16KW
 703054  -54 'SUM'  -53   22   1.      1.      0.0      0.0     *Q=Q+QREF(8.05KW)
 703055  -55 'MIN'  -54   23   1.      0.      0.0      0.0     *0.< Q < 16.1KW
 703056  -56 'MAX'  -55   24  -0.001   0.      0.0      0.0     *
 703057  -57 'SUM'  -56   15   1.      1.      0.0      0.0     *
 703058  -58 'SUM'   42   15   6.     -1.      1.       6.      *(1-SCRAM)*6
 703059  -59 'SUM'  -58   15   1.      1.      1.       7.      *
 703060  -60 'MUL'  -59 -240  -0.0161  1.      1.       0.      *HEAT BACK-UP OUT
 703061  -61 'MUL'  -57   41   1.      1.      1.       0.      *HEATER PUT
*
*          NUCLEAR POWER CONTROL
* TREF*-63
 122000    -2       0.0  272.731    1.E6     272.731
 703063  -63 'FNG' 53    20    1.0    0.0  0.0  272.731 * TREF(C)
*        IDC TYPE   IN1  IN2   G       P1      P2       IC
 703062  -62 'MUL'   15   43   1.      0.      0.       1.      *
 703064  -64 'SUM'  -62   35   1.      1.      1.       0.      *MISS MATCH
 703065  -65 'DER'  -64    0  40.      0.      0.       0.      *
 703066  -66 'LAG'  -65    0  30.     40.      0.       0.      *
 703067  -67 'SUM'  -20  -21   0.5     1.      1.      -0.      *(HL+CL)/2
 703068  -68 'LAG'  -67    0   1.      1.8     0.     273.866   *
 703069  -69 'DER'  -68    0   2.      0.      0.       0.      *
 703070  -70 'LAG'  -69    0  10.      2.      0.       0.      *
 703071  -71 'SUM'  -70  -68   1.      1.      1.      -0.      *COMP. SIG
 703072  -72 'SUM'  -66  -71   1.      1.      1.      -0.      *DEV. SIG
 703073  -73 'SUM'  -72   15   1.      1.   -273.7      0.      *EPSIRON
 703074  -74 'INT'   37    0  -6.2-5   0.      0.       0.      *#2 ROD IN INT
 703075  -75 'INT'   38    0  -6.2-5   0.      0.       0.      *#1 ROD IN INT
 703076  -76 'INT'   39    0   6.2-5   0.      0.       0.      *#1 ROD OUT INT
 703077  -77 'INT'   40    0   6.2-5   0.      0.       0.      *#2 ROD OUT INT
 703078  -78 'SUM'  -74  -75   1.33    1.      1.       0.      *#2+#1 IN
 703079  -79 'SUM'  -76  -77   1.33    1.      1.       0.      *#2+#1 OUT
 703080  -80 'SUM'  -78  -79 144.93    1.      1.       0.      *REAC.($)
 703081  -81 'SUM'   42   15   1.     -1.      1.       1.      *TRIP SIG.
 703082  -82 'MUL'  -80  -81   1.      0.      0.       0.      *TO SCRAM TABLE
 703083  -83 'SUM'  -71   15   1.      1.   -274.697    0.      *DUMMY DT
*************
*GRAVITY CAL*
*************
*       IDC ITYPE INC1 INC2 CGAIN  CP1  CP2     CIC
703084 -84 'FNG'    53   15    1.0   0.0  0.0     0.0    * THETA(CONS. 30.0 DEG)
* THETA   = THETA*SIN(2PAI/TAU*TIME)
703085 -85 'DIV'   96   94    1.0   0.0  0.0  0.41888 * 2PAI/TAU
703086 -86 'MUL' -85    53    1.0   0.0  0.0     0.0  * 2PAI/TAU*TIME
703087 -87 'SIN' -86    00    1.0   0.0  0.0     0.0  *
703088 -88 'MUL' -84   -87    1.0   0.0  0.0     0.0  * THETA(DEG)
* DTHETA  = THETA*2PAI/TAU*COS(2PAI/TAU*TIME)
703089 -89 'COS' -86   00    1.0   0.0  0.0     1.0  *
703090 -90 'MUL' -85  -89    1.0   0.0  0.0  0.41888 *
703091 -91 'MUL' -84  -90    1.0   0.0  0.0     0.0  * DTHETA
* DDTHETA = THETA*4PAI**2/TAU**2*SIN(2PAI/TAU*TIME)
703092 -92 'MUL'  94   94    1.0   0.0  0.0   225.   * TAU**2
703093 -93 'DIV'  97  -92    1.0   0.0  0.0  0.17546 * 4PAI**/TAU**2
703094 -94 'MUL' -93  -87    1.0   0.0  0.0     0.0  *
703095 -95 'MUL' -84  -94    1.0   0.0  0.0     0.0  * DDTHETA
*
703096 -96 'MUL' -88   98    1.0   0.0  0.0     0.0  * THETA(RAD)
703097 -97 'MUL' -91   98    1.0   0.0  0.0     0.0  * ROLLD(RAD)
703098 -98 'MUL' -95   98    1.0   0.0  0.0     0.0  * ROLDD(RAD)
703099 -99 'COS' -96   00    1.0   0.0  0.0     1.0  * COSROL
703100 -100 'SIN' -96  00    1.0   0.0  0.0     0.0  * SINROL
703101 -101 'MUL' -97 -97    1.0   0.0  0.0     0.0  * ROLLD**2
703102 -102 'MUL' -99 -101   1.0   0.0  0.0     0.0  * COSROL*ROLLD**2
703103 -103 'MUL' -100 -98 -1.0    0.0  0.0     0.0  * SINROL*ROLDD
703104 -104 'SUM' -102 -103 .031085 1.0 1.0     0.0  * FORCEV(NORM.)
```

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703105 -105 'MUL' -104 15    4.75  1.0  1.0     0.0  * FORCEV*R
703106 -106 'SUM'  -96 15    1.0   1.0 1.239  1.239  * THO+TH
703107 -107 'COS' -106 00    1.0   0.0  0.0    .326  * COS
703108 -108 'ABS' -107 00    1.0   0.0  0.0    .326  *
703109 -109 'DIV' -107 -108 1.0    0.0  0.0     1.0  * SIGN
703110 -110 'MUL' -109 -105 1.0    0.0  0.0     0.0  * FORCEV*R
703111 -111 'SUM' -110 15    1.0   1.0  1.0     1.0  * FORCEV+1.0
703112 -112 'MUL' 15    15   0.0   0.0  0.0     0.0  * DUMMY
703113 -113 'MUL' 15    15   0.0   0.0  0.0     0.0  * DUMMY
703114 -114 'MUL' 15    15   0.0   0.0  0.0     0.0  * DUMMY
703115 -115 'MUL' 15    15   0.0   0.0  0.0     0.0  * DUMMY
*  LREF
 121900    -2  0.     0.46     1.E6     0.46
 703116 -116 'FNG' 53    19    1.0     0.0  0.0    0.46   * LREF
*
*             S.G.-1 LIQL LEVEL                                  *
*
 703120   -120 'SUM' -111   15    1.      -1.      1.    0.
 703121   -121 'MUL' 100   102    1.       0.      0.   -0.
 703122   -122 'SUM' -121   15    1.       1.     -1.   -0.
 703123   -123 'MUL' -120 -122    1.       0.      0.    0.
 703124   -124 'MUL' -123  101    1.       0.      0.    0.
 703125   -125 'MUL' -124  103    1.       0.      0.    0.
 703126   -126 'SUM' 100   101    1.       1.     -1.   -0.
 703127   -127 'MUL' -111 -126    1.       0.      0.   -0.
 703128   -128 'SUM'  30    32    1.       1.      1.   -0.         *
 703129   -129 'SUM' -128   15    1.       1.   -7.7    -0.         *
 703130   -130 'MUL' -127 -129    1.       0.     0.    -0.         *
 703131   -131 'SUM' -125 -130    1.       1.     1.    -0.         *
 703132   -132 'DIV' -131 -126    1.       0.     0.    -0.         *
 703133  -133 'LAG'  -132    0    1.       2.      0.    3.471      *
*703134  -134 'SUM'  -133 106 23.446   -1.       1.        0.      *(L-LO)
 703134  -134 'SUM'    30 -116 23.446  -1.       1.        0.      *(L-LO)
 703135  -135 'INT'  -134    0  0.00667 0.       0.        0.      *
 703136  -136 'SUM'  -135 -134  0.75    1.       1.        0.      *
 703137  -137 'SUM' -281 -282    5.333  1.      -1.        0.      *+WS-FW
 703138  -138 'SUM' -136 -137    1.      1.       1.        0.      *
 703139  -139 'INT' -138    0    0.05    0.       0.        0.      *
 703140  -140 'SUM' -139 -138    1.      1.       1.        0.      *
 703141  -141 'LAG' -140    0    1.      10.      0.        0.      *
 703142  -142 'DLY' -141 1000    1.      1.       0.        0.     *COMP SIG.
*
*
*             TO FUNCTION GENERATOR                              *
*
 703149  -149 'SUM'   -142   15    1.      1. 71.21596    -0.      0. 100.
 703150   -150 'FNG'  -149    7    1.      0.      0.      12.3734*
*
*             FEED WATER-1 FLOW RATE                             *
****** 151 TO 153 NOT USE
 703151   -151 'SUM' -150   15    1.       1.       0.     12.3733*
 703152   -152 'SUM' -151   15    1.   .0173566   -.0922034  0.12580 *
*
 703153   -153 'XPO'  47   -152  1.       0.       0.    1.33600 *
 703154  -154 'MUL'   -153 -153 .0193488 0.      0.         -0.   *
 703154  -154 'MUL'   -150 -150 .0193488 0.      0.         -0.   *
 703155  -155 'DIV' -166 -154   -1.      0.       0.         -0.   *
 703156  -156 'SUM' -155    15    1.      1.    38.649      0.    *
 703157  -157 'INT' -156     0   0.0333 0.       0.         0.    *
 703158  -158 'SUM' -157 -156    5.      1.       1.         0.    *
 703159  -159 'SUM' -158 -170    1.      1.      -1.         0.    *
 703160  -160 'INT' -159     0  .0033333 0.      0.         0.    *
 703161  -161 'SUM' -160 -159  .07031   1.       1.         0.    *
 703162  -162 'SUM' -161    15   1.      1.     69.4444  -0.     *
 703163  -163 'FNG' -162     8   1.      0.       0.       -0.     *
*
 703164  -164 'LAG' -163     0  .194702 2.       0.     13.521   *
 703165  -165 'SUM' -164    15   1.      1.     -0.621   12.9    *FW 1 FLOW
 703166  -166 'MUL' -165 -165   1.      0.       0.    166.41    *
 703167  -167 'SUM' -165    15   1.  -14.64    954.39   -0.      *
 703168  -168 'SUM' -167    15   1.      1.     29.862  -0.      *
 703169  -169 'SUM' -168    15   1.      1.    -16.353  -0.      *
 703170  -170 'SUM' -169    15    .1     1.   -749.043   0.      *
*
*   SG-2 GRAVITY
*
 703171  -171 'SUM'   -96    15   1.      1.  -1.239   -1.239    *
 703172  -172 'COS' -171    00   1.      0.      0.      .326    *
 703173  -173 'ABS' -172    00   1.      0.      0.      .326    *
 703174  -174 'DIV' -172 -173   1.      0.      0.       1.     *
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 703175 -175 'MUL' -174 -105   1.      0.      0.      0.     *
 703176 -176 'SUM' -175   15   1.      1.      1.      1.     * GRAV.
 703177 -177 'MUL'   15   15   0.      0.      0.      0.     *
*
*            S.G.-2 LIQL LEVEL                                *
*
 703180 -180 'SUM' -176   15   1.     -1.      1.    0.
 703181 -181 'MUL'  104  102   1.      0.      0.   -0.
 703182 -182 'SUM' -181   15   1.      1.     -1.   -0.
 703183 -183 'MUL' -180 -182   1.      0.      0.    0.
 703184 -184 'MUL' -183  105   1.      0.      0.    0.
 703185 -185 'MUL' -184  103   1.      0.      0.    0.
 703136 -186 'SUM'  104  105   1.      1.     -1.   -0.
 703187 -187 'MUL' -176 -186  1.     0.      0.    -0.
 703188 -188 'SUM'   31   33   1.      1.      1.      -0.      *
 703189 -189 'SUM' -188   15   1.      1.     -7.7     -0.      *
 703190 -190 'MUL' -187 -189   1.      0.      0.      -0.      *
 703191 -191 'SUM' -185 -190   1.      1.      1.      -0.      *
 703192 -192 'DIV' -191 -186   1.      0.      0.      -0.      *
 703193 -193 'LAG' -192    0   1.      2.      0.      3.471    *
*703194 -194 'SUM' -193  106 23.446   -1.      1.      0.     *(L-LO)
 703194 -194 'SUM'   31 -116 23.446   -1.      1.      0.     *(L-LO)
 703195 -195 'INT' -194    0  0.00667 0.      0.      0.     *
 703196 -196 'SUN' -195 -194   0.75    1.      1.      0.     *
 703197 -197 'SUM' -283 -284   5.333   1.     -1.      0.     *+WS-FW
 703198 -198 'SUM' -196 -197   1.      1.      1.      0.     *
 703199 -199 'INT' -198    0   0.05    0.      0.      0.     *
 703200 -200 'SUM' -199 -198   1.      1.      1.      0.     *
 703201 -201 'LAG' -200    0   1.     10.      0.      0.     *
 703202 -202 'DLY' -201 1000   1.      1.      0.      0.     *COMP SIG.
*
*
*
*            TO FUNCTION GENERATOR                            *
*
 703209 -209 'SUM'  -202  15   1.      1. 71.21596    -0. 0. 100.
 703210 -210 'FNG' -209    7   1.      0.      0.      -0.   *
*
*            FEED WATER-2 FLOW RATE                           *
*  211 TO 213 NOT USE
 703211 -211 'SUM' -210   15   1.      1.      0.      12.3734*
 703212 -212 'SUM' -211   15   1.  .0173566  -.0922034  0.12580 *
*
 703213 -213 'XPO'   47 -212   1.      0.      0.    1.33600 *
 703214 -214 'MUL' -213 -213 .0193488 0.      0.      -0.     *
 703214 -214 'MUL' -210 -210 .0193488 0.      0.      -0.     *
 703215 -215 'DIV' -226 -214  -1.      0.      0.      -0.     *
 703216 -216 'SUM' -215   15   1.      1.    38.649    0.     *
 703217 -217 'INT' -216    0   0.0333 0.      0.      0.     *
*
 703218 -218 'SUM' -217 -216   5.      1.      1.      0.     *
 703219 -219 'SUM' -218 -230   1.      1.     -1.      0.     *
 703220 -220 'INT' -219    0  .0033333 0.     0.      0.     *
 703221 -221 'SUM' -220 -219  .07031  1.      1.      0.     *
 703222 -222 'SUM' -221   15   1.      1.  69.4444    -0.     *
 703223 -223 'FNG' -222    8   1.      0.      0.      -0.     *
 703224 -224 'LAG' -223    0  .194702 2.      0.     13.521 *
 703225 -225 'SUM' -224   15   1.      1.  -0.621     12.9   *FW 2 FLOW
 703226 -226 'MUL' -225 -225   1.      0.      0.    166.41   *
 703227 -227 'SUM' -225   15   1. -14.64   954.39   -0.     *
 703228 -228 'SUM' -227   15   1.      1.    29.862  -0.     *
 703229 -229 'SUM' -228   15   1.      1.   -16.353  -0.     *
 703230 -230 'SUM' -229   15    .1     1.  -779.043   0.     *
*
*               DUMMY
*
 703231 -231 'MUL'   15   15   0.      0.      0.      0.     *
 703232 -232 'MUL'   15   15   0.      0.      0.      0.     *
 703233 -233 'MUL'   15   15   0.      0.      0.      0.     *
 703234 -234 'MUL'   15   15   0.      0.      0.      0.     *
 703235 -235 'MUL'   15   15   0.      0.      0.      0.     *
 703236 -236 'MUL'   15   15   0.      0.      0.      0.     *
 703237 -237 'MUL'   15   15   0.      0.      0.      0.     *
*
*            PZR HEATER CONTROL
*
 703238 -238 'SUM'   21   48   1.      1.      1.      0.     *TRIP SIGNAL
 703239 -239 'FNG' -238    9   1.      0.      0.      0.     *TRIP SIGNAL
 703240 -240 'MUL' -239   21   1.      0.      0.      0.     *IO 703061
*
```

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*      MAIN STEAM FLOW GOVERNER CONTROL (NOT USED)
*
703241 -241 'SUM'   36 -250   1.      1.     -1.       0.     *
703242 -242 'SUM' -241 -244 .0267835 1.    32.5875  0.     *
703243 -243 'FNG' -242   11   1.      0.      0.       0.     *
703244 -244 'LAG'   50    0   1.      0.1     0.       0.     *
703245 -245 'SUM'   49 -243   1.   3.65497   1.      -0.     *
703246 -246 'SUM'   15   51   1.      1.     -1.       1.     *
703247 -247 'MUL' -285 -246   1.      0.      0.  0.694444 0.   1.   *
703248 -248 'SUM'   53  107   1.      1.     -1.       0.     *
703249 -249 'MUL' -248  108   1.      1.      1.       0.     *
703250 -250 'FNG' -249   13   1.      0.      0.      25.8    *
*
*              EDIT CONTROL OUTPUT
*
703251 -251 'SUM'   13   14   0.5     1.      1.       0.     *LOOP1 TAVE
703252 -252 'SUM'  113  114   0.5     1.      1.       0.     *LOOP2 TAVE
703253 -253 'SUM'   15   15   0.      0.      0.       0.     *DUMMY
703254 -254 'SUM'   70   72   1.      1.      1.    11.305 *SG(A) MIX.LEVEL
703255 -255 'SUM'   71   73   1.      1.      1.    11.305 *SG(B) MIX.LEVEL
703256 -256 'SUM'   74   75   1.      1.      1.       0.     *TOTAL HEAT
703257 -257 'SUM' -256   76   1.      1.      1.       0.     *  GEN. RATIO
703258 -258 'SUM'   77   78   1.      1.      1.       0.     *SG(A) TOTAL
703259 -259 'SUM' -258   79   1.      1.      1.       0.     *  HEAT REM.
703260 -260 'SUM' -259   80   1.      1.      1.       0.     *     RATIO
703261 -261 'SUM'   81   82   1.      1.      1.       0.     *SG(B) TOTAL
703262 -262 'SUM' -261   83   1.      1.      1.       0.     *  HEAT REM.
703263 -263 'SUM' -262   84   1.      1.      1.       0.     *     RATIO
703264 -264 'DIV' -257   85   1.      0.      0.       1.     *HEAT GEN. RATIO
703265 -265 'DIV' -260   86   1.      0.      0.       1.     *SG(A) HEAT REM.RATIO
703266 -266 'DIV' -263   87   1.      0.      0.       1.     *SG(B) HEAT REM.RATIO
703267 -267 'SUM' -260 -263   1.      1.      1.       0.     *TOTAL HEAT REM.
703268 -268 'SUM'   86   87   1.      1.      1.       0.     *INITIAL HEAT REM.
703269 -269 'DIV' -267 -268   1.      0.      0.       1.     *TOTAL HEAT REM.RATIO
703270 -270 'INT'   88    0   1.      0.      0.       0.     *S.L. DUMP OUT MASS
703271 -271 'INT'   89    0   1.      0.      0.       0.     *S.L. SV#1 OUT MASS
703272 -272 'INT'   90    0   1.      0.      0.       0.     *S.L. SV#2 OUT MASS
703273 -273 'INT'   91    0   1.      0.      0.       0.     *PZR PORV OUT MASS
703274 -274 'INT'   92    0   1.      0.      0.       0.     *PZR SV OUT MASS
703275 -275 'MUL'   15   15   0.      0.      0.       0.     *DUMMY
* FOR BUBBLE DETA(MOD2 ====> MOD3 )
703276 -276 'MUL'   61   15   1.      0.      0.       0.
703277 -277 'MUL'   63   15   1.      0.      0.       0.
703278 -278 'MUL'   64   15   1.      0.      0.       0.
703279 -279 'MUL'   66   15   1.      0.      0.       0.
703280 -280 'MUL'   67   15   1.      0.      0.       0.
* FOR S.G.-1 F.W. CONT.
703281 -281 'LAG'   26    0   1.      2.0     0.     12.9     *
703282 -282 'LAG' -165    0   1.      2.0     0.     12.9     *
* FOR S.G.-2 F.W. CONT.
703283 -283 'LAG'   28    0   1.      2.0     0.     12.9     *
703284 -284 'LAG' -225    0   1.      2.0     0.     12.9     *
* FOR MAIN STEAM GOVERNER CONT.
703285 -285 'LAG' -245    0   1.      2.0     0.   0.694444 *
* FOR TRIP 9
703286 -286 'LAG'   32    0   1.      2.0     0.     10.711 *
*
*****  ADD 90' *****
* C/R POSITION  (FOR EDIT)
703287 -287 'INT'   37    0 -1.33    0.      0.       0. *#2 IN
703288 -288 'INT'   38    0 -1.33    0.      0.       0. *#1 IN
703289 -289 'INT'   39    0  1.33    0.      0.       0. *#1 OUT
703290 -290 'INT'   40    0  1.33    0.      0.       0. *#2 OUT
703291 -291 'SUM' -288 -289  1.0     1.      1.       0. *#1 POSITION(MM)
703292 -292 'SUM' -287 -290  1.0     1.      1.       0. *#2 POSITION(MM)
* PRZ LEVEL CONTROL
703293 -293 'SUM'   26   28  2.668   1.      1.      -0. *%STEAM FLOW
703294 -294 'FNG' -293   16  1.0     0.      0.      -0. *LREF(%)
703295 -295 'SUM'  -13  110  40.  0.3048     1.      -0. *LIQL(%)
703296 -296 'SUM' -294 -295  1.0     1.     -1.      -0. *
703297 -297 'SUM' -296   15  1.0     1. -0.42162     0. *
703298 -298 'INT' -297    0 6.6667-4 0.      0.       0. *
703299 -299 'SUM' -297 -298  4.0     1.      1.       0. *
703300 -300 'SUM'   15 -299  1.0    50.     -1.      -0. *
703301 -301 'SUM' -300 -316  1.0     1.    -90.       0. *
703302 -302 'INT' -301    0 0.16667  0.      0.       0. *
703303 -303 'SUM' -301 -302  0.33    1.      1.       0. *
703304 -304 'LAG' -303    0  1.0     1.      0.      0.     *
* -305 INITIAL VALUE MUST BE ADJUST.(-317 OUTPUT =0.0)
703305 -305 'SUM' -304   15  1.0     1. 69.345  69.345  0. 100. *
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 703306 -306 'FNG' -305   17  1.0      0.       0.      -0. *CV1
 703307 -307 'FNG' -305   18  1.0      0.       0.      -0. *CV2
 703308 -308 'DIV' -306 -307  1.0      0.       0.      -0. *CV1/CV2
 703309 -309 'MUL' -308 -308  1.0      0.       0.      -0. *(CV1/CV2)**2
 703310 -310 'SUM'   15 -309  1.0      1.       1.      -0. *
 703311 -311 'DIV'    3 -310 16.02     0.       0.      -0. *
 703312 -312 'SUM'  112   15 0.07031   1.   -14.7       -0. *C/L PRES(KG/CM2.G)
 703313 -313 'SUM' -312   15  1.0      1.   -15.0       -0. *
 703314 -314 'MUL' -311 -313  1.0      0.     0.0       -0. *
 703315 -315 'XPO' -314   18  1.0      0.     0.0       -0. *
 703316 -316 'MUL' -306 -315 .008565   0.     0.0       -0. *LET-DOWN(KG/S)
 703317 -317 'SUM' -316   15  2.205   -1.   0.55556      0. *C.P.FLOW(LB/S)
* FOR EDIT
 703318 -318 'INT' -317    0  1.0      0.  0.      0. *INT(C.P.FLOW)LB/S
 703319 -319 'SUM'   27   26  1.0      1. -1.      0. *SG-1 FW-STEAM(LB/SEC)
 703320 -320 'INT' -319    0  1.0      0.  0.      0. *INT(SG-1)
 703321 -321 'SUM'   29   28  1.0      1. -1.      0. *SG-2 FW-STEAM(LB/SEC)
 703322 -322 'INT' -321    0  1.0      0.  0.      0. *INT(SG-2)
*
* SPINDLE  LIFT
703340 -340 'SUM'   36    15 1633.   1.0  -8.8 -0. *STEAM-(BASE STEAM)KG/H
703341 -341 'FNG' -340    21  1.0   0.0    0.0 -0. *VALVE LIFT(MM)
703342 -342 'SUM' -341    15  1.0 1.4684 17.0 -0. *SPINDLE LIFT(%)
*
*     AUX. DNBR CALCULATION DATA
*
 800100    1    0    1    1    0    11    3  *
 800200    1.      2.061  1.      0.9136 1.      0.5       2.9   *
 800300     .0492   .0345  .0547 0.      1.                       *
 800400     .01     .051   .1     .5141  .2      .9289     .3        1.2566 *
 800401     .4     1.4663  .5    1.5385  .6     1.4663     .7        1.2566 *
 800402     .8      .9289  .9     .5141  .99     .0510                      *
 800500    3    4    5   *
*
* FOR SG1 FEED WATER FLOW CONTROL
* FOR SG STEAM PRESSURE BOUNDARY
 010001 -1 16 1 61 42 11 1 60 2 13 23 16 11 2 3 3 2 0 3 1 0 0 2 0  0 1 1 1 1
 130700    1 1000  -710   0  0.          0.        274.0  690.  *SG 2 FEED WATER
 130800    1 1000  -700   0  0.          0.        274.0  690.  *SG 1 FEED WATER
 701000          115      310    *
703700 -700 'FNG'   53    22 1.0     0.0    0.0  12.9       *FW 1
703710 -710 'FNG'   53    23 1.0     0.0    0.0  12.9       *FW 2
 122200    10     * NO.1 S.G. FEED WATER FLOW (LB/S)
 122201      .0  12.9     24.   12.9     51.   14.21  150.   14.7
 122202  255.  14.58  261.  13.23  303.  12.31
 122203  620.  12.31  630.   12.1   780.  12.1
 122300    11     * NO.2 S.G. FEED WATER FLOW (LB/S)
 122301      .0  12.9     24.   12.9     51.   14.21  150.   14.7
 122302   251.  14.58  258.  13.0    276.  12.25  330.   11.7
 122303  624.   11.70  627.  12.86  780.  12.86
*
* FOR SG STEAM PRESSURE BOUNDARY
 010001 -1 16 1 61 42 11 1 60 2 13 23 16 11 2 3 3 2 0 3 1 0 0 2 0  0 1 1 1 1
*
 051701  0  1   55.9   0.     1.   1.+9    50.0     50.0     *MAIN TURBINE
 051702    0.     1.+7      0.    -10.0               *MAIN TURBINE
 051709    0.        0.        0.       0.       0.       1.
*          TIME DEPENDENT VOLUME
*             TIME    PRES     TEMP   QUA    MIXL        P
 070101   7   0.0      0.0     494.1   1.     50.    * 654.7
 070102      30.0      0.0     494.1   1.     50.    * 654.7
 070103     167.0      0.0     492.6   1.     50.    * 646.2
 070104     263.0      0.0     492.6   1.     50.    * 646.2
 070105     323.0      0.0     493.8   1.     50.    * 653.3
 070106     375.0      0.0     494.6   1.     50.    * 657.6
 070107     420.0      0.0     494.6   1.     50.    * 657.6
 081601 160 170  0  0 25.8      0.2736  6.777   0.      -1.      0. *TURBINE VALVE
 081602   0  -1   2   0   0.      1.  -99  0    0.   0   *
 702035     35  'WP**'  160    -.026677    -0.2433  *STLINE-1 FLOW (WS)
 702036     36  'WP**'  160      1.          9.4     *STLINE-2 FLOW (WS)
*
*******************************************************************************
*                  FOR GRAVITY CAHNGE                                          *
*******************************************************************************
*  TABLE 24 = ROLL ANGLE(DEG)
*        25 = PITCH ANGLE(DEG)
*        26 = YAW ANGLE VELOCITY(DEG/S)
*        27 = LEFT & RIGHT ACCE.(G)
*        28 = SG2 Z-ACC.(G)
*        29 = PRZ Z-ACC.(G)
```

```
*
 010001 -1 16 1 61 42 11 1 60 2 13 29 16 11 2 3 3 2 0 3 1 0 0 2 0  0 1 1 1 1
*     ITOMGH IPHIZ IPHIZD IPHI2D ITHEY ITHEYD ITHE2D IZETX IZETXD IZET2D
 010004 -609  -608   -606   -607  -600   -601   -602  -603   -604   -605
 701000        120    336    *
703600 -600 'FNG'    53   24  1.0    0.0    0.0  -0.0  *ROLL ANGLE(DEG)
703601 -601 'DER' -600     0  1.0    0.0    0.0  -0.0  *ROLL ANGLE-D(DEG/S)
703602 -602 'DER' -601     0  1.0    0.0    0.0  -0.0  *ROLL ANGLE-2D(DEG/S2)
703603 -603 'FNG'    53   25 -1.0    0.0    0.0  -0.0  *PITCH ANGLE(DEG)
703604 -604 'DER' -603     0  1.0    0.0    0.0  -0.0  *PITCH ANGLE-D(DEG/S)
703605 -605 'DER' -604     0  1.0    0.0    0.0  -0.0  *PITCH ANGLE-2D(DEG/S2)
703606 -606 'FNG'    53   26 -1.0    0.0    0.0  -0.0  *YAW ANGLE-D(DEG/S)
703607 -607 'DER' -606     0  1.0    0.0    0.0  -0.0  *YAW ANGLE-2D(DEG/S2)
703608 -608 'INT' -606     0  1.0    0.0    0.0  -0.0  *YAW ANGLE(DEG)
703609 -609 'FNG'    53   27 0.102  0.0    0.0  -0.0  *L-R NORM. ACC.(-)
*  FOR S.G DETECTED LEVEL
 702106  106 'CONS'    0    2.985    2.985    * L-REF
 703110 -110 'FNG'    53    28  -1.    0.0    0.0  -0.0  *SG-Z ACC.(G)
 703111 -111 'SUM'   -110   15 0.102  1.0    9.8  -0.0  *SG-Z ACC.(NORM.)
 703129 -129 'SUM'   -128   15   1.    1.0 -8.186 -0.0
 703133 -133 'LAG'   -132    0   1.     2.      0.    2.985    *
 703134 -134 'SUM'   -133  106 23.446  -1.      1.    0.0      *
 703176 -176 'SUM'   -111   15   1.     1.      0.    0.0      *
 703189 -189 'SUM'   -188   15   1.    1.0 -8.186 -0.0
 703193 -193 'LAG'   -192    0   1.     2.      0.    2.985    *
 703194 -194 'SUM'   -193  106 23.446  -1.      1.    0.0      *
*  FOR PRZ DETECTED LEVEL
 702116    116  'CONS'    0      8.2025     8.2025  * 2.5M
 702117    117  'CONS'    0      61.67      61.67   * KIJYUN-KYAKU RHO
 702118    118  'CONS'    0      0.5543     0.5543  * PRZ BASE LEVEL
 702119    119  'VL**'   32      1.0       -0.0     * LIQ. SPECIFIC VOL
 702120    120  'VS**'   32      1.0       -0.0     * GAS  SPECIFIC VOL
*109=LIQL 31   115=LIQL 32
703401 -401 'FNG'    53    29 -1.0   0.0    0.0  -0.*PRZ-Z ACC(G)
703402 -402 'SUM' -401    15 0.102  1.0    9.8  -0.*PRZ-Z ACC(NORM.)
703410 -410 'DIV'    15   119  1.0   0.0    0.0  -0.*RHOL
703411 -411 'DIV'    15   120  1.0   0.0    0.0  -0.*RHOG
703412 -412 'SUM'   117  -411 8.2025 1.0   -1.0  -0.*(RHOA-RHOG)*8.2025
703413 -413 'SUM'    15  -402  1.0   1.0   -1.0  -0.*1-BETA
703414 -414 'MUL' -412  -413  1.0   0.0    0.0  -0.*
703415 -415 'SUM' -410  -411  1.0   1.0   -1.0  -0.*RHOL-RHOG
703416 -416 'SUM'   109   115  1.0   1.0    1.0  -0.*PRZ LIQL
703417 -417 'SUM' -416   118  1.0   1.0   -1.0  -0.*PRZ LIQL-0.5543
703418 -418 'MUL' -417  -415  1.0   0.0    0.0  -0.*
703419 -419 'MUL' -418  -402  1.0   0.0    0.0  -0.*
703420 -420 'SUM' -419  -414  1.0   1.0    1.0  -0.*
703421 -421 'DIV' -420  -415  1.0   0.0    0.0  -0.*DETECTED LEVEL(FT)
703422 -422 'DIV' -421   116 100.   0.0    0.0  -0.*DETECTED LEVEL(%)
703423 -423 'LAG' -422     0   1.   2.0 0.0 45.300  *DETECTED LEVEL(%)
 703296 -296 'SUM' -294 -423  1.0     1.    -1.      -0. *
*
 122400 781      * ROLL ANGLE (DEG)
 122401       .0  .5420E+00    1.0  .5420E+00    2.0  .5420E+00    3.0  .4248E+00
+            4.0  .4248E+00    5.0  .6738E+00    6.0  .9229E+00    7.0  .1011E+01
+            8.0  .1025E+01    9.0  .8057E+00   10.0  .1758E+00   11.0 -.4102E+00
 122402     12.0 -.7764E+00   13.0 -.9082E+00   14.0 -.7471E+00   15.0 -.1611E+00
+           16.0  .3369E+00   17.0  .1011E+01   18.0  .1099E+01   19.0  .8350E+00
+           20.0  .4248E+00   21.0 -.4395E-01   22.0 -.6445E+00   23.0 -.1260E+01
 122403     24.0 -.1846E+01   25.0 -.2563E+01   26.0 -.2915E+01   27.0 -.2959E+01
+           28.0 -.2344E+01   29.0 -.1128E+01   30.0  .4102E+00   31.0  .1729E+01
+           32.0  .2358E+01   33.0  .2212E+01   34.0  .1509E+01   35.0  .1904E+00
 122404     36.0 -.1143E+01   37.0 -.2212E+01   38.0 -.2798E+01   39.0 -.2681E+01
+           40.0 -.2080E+01   41.0 -.1172E+01   42.0 -.1758E+00   43.0  .8496E+00
+           44.0  .1714E+01   45.0  .2153E+01   46.0  .2109E+01   47.0  .1421E+01
 122405     48.0  .3223E+00   49.0 -.8643E+00   50.0 -.1729E+01   51.0 -.2314E+01
+           52.0 -.2314E+01   53.0 -.1831E+01   54.0 -.8936E+00   55.0  .4102E+00
+           56.0  .1743E+01   57.0  .2900E+01   58.0  .3208E+01   59.0  .2593E+01
 122406     60.0  .1289E+01   61.0 -.1758E+00   62.0 -.1479E+01   63.0 -.2065E+01
+           64.0 -.1846E+01   65.0 -.1216E+01   66.0 -.2783E+00   67.0  .6738E+00
+           68.0  .1509E+01   69.0  .2109E+01   70.0  .2036E+01   71.0  .1509E+01
 122407     72.0  .6445E+00   73.0 -.1904E+00   74.0 -.9814E+00   75.0 -.1362E+01
+           76.0 -.1245E+01   77.0 -.9082E+00   78.0 -.4395E+00   79.0  .7324E-01
+           80.0  .7910E+00   81.0  .1274E+01   82.0  .1758E+01   83.0  .2109E+01
 122408     84.0  .2007E+01   85.0  .1509E+01   86.0  .5127E+00   87.0 -.2930E+00
+           88.0 -.1392E+01   89.0 -.2446E+01   90.0 -.3047E+01   91.0 -.3149E+01
+           92.0 -.2563E+01   93.0 -.1362E+01   94.0  .1904E+00   95.0  .1523E+01
 122409     96.0  .2578E+01   97.0  .2944E+01   98.0  .2563E+01   99.0  .1450E+01
+          100.0 -.4395E-01  101.0 -.1494E+01  102.0 -.2622E+01  103.0 -.2930E+01
+          104.0 -.2813E+01  105.0 -.1963E+01  106.0 -.7471E+00  107.0  .6152E+00
 122410    108.0  .1758E+01  109.0  .2227E+01  110.0  .1743E+01  111.0  .5420E+00
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+	112.0	-.4395E+00	113.0	-.1714E+01	114.0	-.2798E+01	115.0	-.3281E+01
+	116.0	-.3047E+01	117.0	-.2227E+01	118.0	-.9961E+00	119.0	.2637E+00
122411	120.0	.1128E+01	121.0	.1274E+01	122.0	.1025E+01	123.0	.3369E+00
+	124.0	-.6738E+00	125.0	-.1699E+01	126.0	-.2329E+01	127.0	-.2314E+01
+	128.0	-.1714E+01	129.0	-.4688E+00	130.0	.6592E+00	131.0	.1538E+01
122412	132.0	.2036E+01	133.0	.2021E+01	134.0	.1465E+01	135.0	.4541E+00
+	136.0	-.7910E+00	137.0	-.1992E+01	138.0	-.2915E+01	139.0	-.3179E+01
+	140.0	-.2622E+01	141.0	-.1333E+01	142.0	.2783E+00	143.0	.1860E+01
122413	144.0	.3062E+01	145.0	.3662E+01	146.0	.3120E+01	147.0	.1743E+01
+	148.0	-.1611E+00	149.0	-.1948E+01	150.0	-.3281E+01	151.0	-.3882E+01
+	152.0	-.3530E+01	153.0	-.2227E+01	154.0	-.5420E+00	155.0	.1318E+01
122414	156.0	.2534E+01	157.0	.3062E+01	158.0	.2725E+01	159.0	.1743E+01
+	160.0	.3076E+00	161.0	-.1084E+01	162.0	-.1963E+01	163.0	-.2080E+01
+	164.0	-.1582E+01	165.0	-.4395E+00	166.0	.7910E+00	167.0	.1553E+01
122415	168.0	.1758E+01	169.0	.1465E+01	170.0	.6592E+00	171.0	-.1611E+00
+	172.0	-.9814E+00	173.0	-.1611E+01	174.0	-.1934E+01	175.0	-.1816E+01
+	176.0	-.1362E+01	177.0	-.6592E+00	178.0	-.4395E-01	179.0	.5127E+00
122416	180.0	.5566E+00	181.0	.4248E+00	182.0	.7324E-01	183.0	-.1611E+00
+	184.0	-.5713E+00	185.0	-.9961E+00	186.0	-.1479E+01	187.0	-.1582E+01
+	188.0	-.1479E+01	189.0	-.1128E+01	190.0	-.7764E+00	191.0	-.2051E+00
122417	192.0	.3076E+00	193.0	.8643E+00	194.0	.1055E+01	195.0	.1025E+01
+	196.0	.5420E+00	197.0	-.3662E+00	198.0	-.1377E+01	199.0	-.1948E+01
+	200.0	-.2358E+01	201.0	-.2095E+01	202,0	-.1245E+01	203.0	-.4395E-01
122418	204.0	.1157E+01	205.0	.1802E+01	206.0	.1992E+01	207.0	.1626E+01
+	208.0	.8203E+00	209.0	-.5859E-01	210.0	-.8789E+00	211.0	-.1216E+01
+	212.0	-.1289E+01	213.0	-.1143E+01	214.0	-.7617E+00	215.0	-.1611E+00
122419	216.0	.4395E+00	217.0	.9375E+00	218.0	.1274E+01	219.0	.1406E+01
+	220.0	.1260E+01	221.0	.1274E+01	222.0	.1157E+01	223.0	.9521E+00
+	224.0	.5566E+00	225.0	.7324E-01	226.0	-.5273E+00	227.0	-.1011E+01
122420	228.0	-.1011E+01	229.0	-.5273E+00	230.0	.3223E+00	231.0	.1392E+01
+	232.0	.2344E+01	233.0	.2710E+01	234.0	.2505E+01	235.0	.1362E+01
+	236.0	.1904E+00	237.0	-.1157E+01	238.0	-.2080E+01	239.0	-.2446E+01
122421	240.0	-.2314E+01	241.0	-.1699E+01	242.0	-.5859E+00	243.0	.4248E+00
+	244.0	.1025E+01	245.0	.1143E+01	246.0	.1143E+01	247.0	.7910E+00
+	248.0	.7324E-01	249.0	-.7617E+00	250.0	-.1377E+01	251.0	-.1597E+01
122422	252.0	-.1348E+01	253.0	-.7764E+00	254.0	-.4102E+00	255.0	.0000E+00
+	256.0	.1904E+00	257.0	.1758E+00	258.0	-.4395E-01	259.0	-.5273E+00
+	260.0	-.1304E+01	261.0	-.1846E+01	262.0	-.2212E+01	263.0	-.1978E+01
122423	264.0	-.1479E+01	265.0	-.5273E+00	266.0	.3076E+00	267.0	.9082E+00
+	268.0	.1157E+01	269.0	.9082E+00	270.0	.4395E+00	271.0	-.2783E+00
+	272.0	-.9521E+00	273.0	-.1362E+01	274.0	-.1479E+01	275.0	-.1377E+01
122424	276.0	-.9229E+00	277.0	-.5127E+00	278.0	-.1611E+00	279.0	.3076E+00
+	280.0	.7910E+00	281.0	.1025E+01	282.0	.1025E+01	283.0	.9229E+00
+	284.0	.5420E+00	285.0	.5859E-01	286.0	-.4102E+00	287.0	-.7617E+00
122425	288.0	-.1040E+01	289.0	-.1113E+01	290.0	-.7178E+00	291.0	-.1025E+00
+	292.0	.4980E+00	293.0	.9082E+00	294.0	.1274E+01	295.0	.1274E+01
+	296.0	.1274E+01	297.0	.8057E+00	298.0	.1172E+00	299.0	-.5273E+00
122426	300.0	-.1128E+01	301.0	-.1553E+01	302.0	-.1260E+01	303.0	-.5273E+00
+	304.0	.1611E+00	305.0	.1143E+01	306.0	.2021E+01	307.0	.2710E+01
+	308.0	.2944E+01	309.0	.2827E+01	310.0	.2153E+01	311.0	.1025E+01
122427	312.0	-.1904E+00	313.0	-.1450E+01	314.0	-.2314E+01	315.0	-.2578E+01
+	316.0	-.2212E+01	317.0	-.1362E+01	318.0	-.2197E+00	319.0	.1128E+01
+	320.0	.2344E+01	321.0	.3193E+01	322.0	.3442E+01	323.0	.3047E+01
122428	324.0	.1978E+01	325.0	.6592E+00	326.0	-.6885E+00	327.0	-.1846E+01
+	328.0	-.2637E+01	329.0	-.2813E+01	330.0	-.2432E+01	331.0	-.1362E+01
+	332.0	-.1611E+00	333.0	.1011E+01	334.0	.1714E+01	335.0	.1904E+01
122429	336.0	.1626E+01	337.0	.9082E+00	338.0	-.2197E+00	339.0	-.1494E+01
+	340.0	-.2285E+01	341.0	-.2563E+01	342.0	-.1963E+01	343.0	-.1055E+01
+	344.0	.7324E-01	345.0	.1216E+01	346.0	.1875E+01	347.0	.1875E+01
122430	348.0	.1143E+01	349.0	-.4395E-01	350.0	-.1245E+01	351.0	-.2212E+01
+	352.0	-.2607E+01	353.0	-.2329E+01	354.0	-.1714E+01	355.0	-.7617E+00
+	356.0	-.4395E-01	357.0	.4395E+00	358.0	.7910E+00	359.0	.9082E+00
122431	360.0	.6885E+00	361.0	.3076E+00	362.0	-.1904E+00	363.0	-.5127E+00
+	364.0	-.8643E+00	365.0	-.7764E+00	366.0	-.3516E+00	367.0	.7324E-01
+	368.0	.6738E+00	369.0	.1157E+01	370.0	.1392E+01	371.0	.1260E+01
122432	372.0	.8496E+00	373.0	.7324E-01	374.0	-.3955E+00	375.0	-.5420E+00
+	376.0	-.6299E+00	377.0	-.4102E+00	378.0	.5859E-01	379.0	.6006E+00
+	380.0	.1143E+01	381.0	.1494E+01	382.0	.1538E+01	383.0	.1274E+01
122433	384.0	.8203E+00	385.0	.3076E+00	386.0	-.2930E-01	387.0	-.1611E+00
+	388.0	-.1611E+00	389.0	-.2930E-01	390.0	.1758E+00	391.0	.4395E+00
+	392.0	.6738E+00	393.0	.6299E+00	394.0	.6592E+00	395.0	.6299E+00
122434	396.0	.5566E+00	397.0	.3076E+00	398.0	.7324E-01	399.0	-.8789E-01
+	400.0	-.2783E+00	401.0	-.4980E+00	402.0	-.6299E+00	403.0	-.7617E+00
+	404.0	-.9229E+00	405.0	-.8936E+00	406.0	-.5420E+00	407.0	.1025E+00
122435	408.0	.9229E+00	409.0	.1494E+01	410.0	.1523E+01	411.0	.1040E+01
+	412.0	.1904E+00	413.0	-.7764E+00	414.0	-.1553E+01	415.0	-.2007E+01
+	416.0	-.2095E+01	417.0	-.1904E+01	418.0	-.1611E+01	419.0	-.1011E+01
122436	420.0	-.3955E+00	421.0	.5859E-01	422.0	.4541E+00	423.0	.5566E+00
+	424.0	.1904E+00	425.0	-.4102E+00	426.0	-.9961E+00	427.0	-.1465E+01
+	428.0	-.1611E+01	429.0	-.1523E+01	430.0	-.1113E+01	431.0	-.5273E+00

122437	432.0	-.5859E-01	433.0	.1465E+00	434.0	.7324E-01	435.0	-.1318E+00
+	436.0	-.4834E+00	437.0	-.7764E+00	438.0	-.8350E+00	439.0	-.8789E+00
+	440.0	-.7617E+00	441.0	-.7617E+00	442.0	-.9668E+00	443.0	-.1128E+01
122438	444.0	-.1011E+01	445.0	-.6885E+00	446.0	-.2783E+00	447.0	.1904E+00
+	448.0	.6738E+00	449.0	.9082E+00	450.0	.1157E+01	451.0	.1113E+01
+	452.0	.7910E+00	453.0	.3369E+00	454.0	-.4395E-01	455.0	-.4102E+00
122439	456.0	-.7471E+00	457.0	-.7617E+00	458.0	-.6592E+00	459.0	-.3516E+00
+	460.0	.4395E-01	461.0	.5127E+00	462.0	.7617E+00	463.0	.7764E+00
+	464.0	.6738E+00	465.0	.5566E+00	466.0	.2490E+00	467.0	.7324E-01
122440	468.0	.7324E-01	469.0	.1758E+00	470.0	.3076E+00	471.0	.7617E+00
+	472.0	.1040E+01	473.0	.1143E+01	474.0	.1099E+01	475.0	.6738E+00
+	476.0	-.1318E+00	477.0	-.8643E+00	478.0	-.1274E+01	479.0	-.1465E+01
122441	480.0	-.1289E+01	481.0	-.7617E+00	482.0	.1904E+00	483.0	.1362E+01
+	484.0	-.2271E+01	485.0	.2710E+01	486.0	.2622E+01	487.0	.1992E+01
+	488.0	.9082E+00	489.0	-.2783E+00	490.0	-.1362E+01	491.0	-.2095E+01
122442	492.0	-.2314E+01	493.0	-.1846E+01	494.0	-.8789E+00	495.0	.8789E-01
+	496.0	.1040E+01	497.0	.1465E+01	498.0	.1274E+01	499.0	.5859E+00
+	500.0	-.3955E+00	501.0	-.1128E+01	502.0	-.1611E+01	503.0	-.1611E+01
122443	504.0	-.1392E+01	505.0	-.8936E+00	506.0	-.3955E+00	507.0	.1465E-01
+	508.0	.3223E+00	509.0	.1465E+00	510.0	-.2637E+00	511.0	-.6445E+00
+	512.0	-.7617E+00	513.0	-.6445E+00	514.0	-.3076E+00	515.0	.7324E-01
122444	516.0	.7324E-01	517.0	-.2930E-01	518.0	-.3516E+00	519.0	-.6299E+00
+	520.0	-.7617E+00	521.0	-.5273E+00	522.0	-.1318E+00	523.0	.2051E+00
+	524.0	.4248E+00	525.0	.5420E+00	526.0	.4248E+00	527.0	.4248E+00
122445	528.0	.1904E+00	529.0	-.4395E-01	530.0	-.5859E-01	531.0	-.1611E+00
+	532.0	-.3955E+00	533.0	-.4248E+00	534.0	-.5566E+00	535.0	-.7324E+00
+	536.0	-.6445E+00	537.0	-.3955E+00	538.0	-.4395E-01	539.0	.4834E+00
122446	540.0	.7910E+00	541.0	.7910E+00	542.0	.6885E+00	543.0	.5566E+00
+	544.0	.3076E+00	545.0	.7324E-01	546.0	-.4395E-01	547.0	-.1611E+00
+	548.0	.8789E-01	549.0	.4395E+00	550.0	.6738E+00	551.0	.7910E+00
122447	552.0	.6592E+00	553.0	.4248E+00	554.0	.7324E-01	555.0	-.2930E+00
+	556.0	-.6592E+00	557.0	-.7910E+00	558.0	-.5273E+00	559.0	.4395E-01
+	560.0	.6738E+00	561.0	.1025E+01	562.0	.1025E+01	563.0	.5420E+00
122448	564.0	-.1611E+00	565.0	-.9521E+00	566.0	-.1494E+01	567.0	-.1729E+01
+	568.0	-.1494E+01	569.0	-.8789E+00	570.0	-.1611E+00	571.0	.4688E+00
+	572.0	.1025E+01	573.0	.1157E+01	574.0	.9082E+00	575.0	.4248E+00
122449	576.0	-.4248E+00	577.0	-.1494E+01	578.0	-.2212E+01	579.0	-.2329E+01
+	580.0	-.1948E+01	581.0	-.1362E+01	582.0	-.4980E+00	583.0	.3516E+00
+	584.0	.1128E+01	585.0	.1509E+01	586.0	.1260E+01	587.0	.6738E+00
122450	588.0	-.1465E-01	589.0	-.6445E+00	590.0	-.1128E+01	591.0	-.1362E+01
+	592.0	-.1245E+01	593.0	-.7617E+00	594.0	-.7324E-01	595.0	.4248E+00
+	596.0	.6592E+00	597.0	.6738E+00	598.0	.3223E+00	599.0	-.2783E+00
122451	600.0	-.1055E+01	601.0	-.1816E+01	602.0	-.2314E+01	603.0	-.2212E+01
+	604.0	-.1567E+01	605.0	-.2637E+00	606.0	.1143E+01	607.0	.2227E+01
+	608.0	.2681E+01	609.0	.2578E+01	610.0	.1860E+01	611.0	.5273E+00
122452	612.0	-.4395E+00	613.0	-.1494E+01	614.0	-.2080E+01	615.0	-.2197E+01
+	616.0	-.1714E+01	617.0	-.8643E+00	618.0	-.2930E-01	619.0	.6738E+00
+	620.0	.1230E+01	621.0	.1304E+01	622.0	.1260E+01	623.0	.1143E+01
122453	624.0	.1040E+01	625.0	.6738E+00	626.0	.0000E+00	627.0	-.6299E+00
+	628.0	-.1069E+01	629.0	-.1362E+01	630.0	-.1128E+01	631.0	-.5273E+00
+	632.0	.7324E-01	633.0	.6592E+00	634.0	.1025E+01	635.0	.1143E+01
122454	636.0	.9082E+00	637.0	.4248E+00	638.0	-.4395E-01	639.0	-.3955E+00
+	640.0	-.5273E+00	641.0	-.3955E+00	642.0	-.1318E+00	643.0	.1465E-01
+	644.0	-.1465E-01	645.0	-.4395E-01	646.0	-.1758E+00	647.0	-.2490E+00
122455	648.0	-.1611E+00	649.0	-.5859E-01	650.0	-.4395E-01	651.0	.7324E-01
+	652.0	.7324E-01	653.0	.7324E-01	654.0	-.2930E-01	655.0	-.1611E+00
+	656.0	-.5273E+00	657.0	-.1128E+01	658.0	-.1494E+01	659.0	-.1479E+01
122456	660.0	-.1245E+01	661.0	-.6445E+00	662.0	.7324E-01	663.0	.7910E+00
+	664.0	.1274E+01	665.0	.1143E+01	666.0	.6152E+00	667.0	.8789E-01
+	668.0	-.4102E+00	669.0	-.5273E+00	670.0	-.2783E+00	671.0	-.1611E+00
122457	672.0	.5859E-01	673.0	.1904E+00	674.0	-.5859E-01	675.0	-.5273E+00
+	676.0	-.9082E+00	677.0	-.1143E+01	678.0	-.8350E+00	679.0	-.2930E+00
+	680.0	.1172E+00	681.0	.4248E+00	682.0	.6738E+00	683.0	.7910E+00
122458	684.0	.6592E+00	685.0	.3076E+00	686.0	.4395E-01	687.0	-.2783E+00
+	688.0	-.5273E+00	689.0	-.5273E+00	690.0	-.3955E+00	691.0	-.2051E+00
+	692.0	-.4395E-01	693.0	.5859E-01	694.0	.2051E+00	695.0	.2930E+00
122459	696.0	.2197E+00	697.0	.1904E+00	698.0	.1904E+00	699.0	.7324E-01
+	700.0	-.4395E-01	701.0	-.2930E-01	702.0	-.4395E-01	703.0	.7324E-01
+	704.0	.1904E+00	705.0	.3076E+00	706.0	.3516E+00	707.0	.3076E+00
122460	708.0	-.4395E-01	709.0	-.1611E+00	710.0	-.2783E+00	711.0	-.4688E+00
+	712.0	-.7471E+00	713.0	-.1011E+01	714.0	-.1128E+01	715.0	-.7910E+00
+	716.0	-.4102E+00	717.0	.5859E-01	718.0	.4248E+00	719.0	.4248E+00
122461	720.0	.3076E+00	721.0	-.1465E+00	722.0	-.5127E+00	723.0	-.1011E+01
+	724.0	-.1509E+01	725.0	-.1846E+01	726.0	-.1934E+01	727.0	-.1670E+01
+	728.0	-.1011E+01	729.0	-.4395E-01	730.0	.8203E+00	731.0	.1523E+01
122462	732.0	.1509E+01	733.0	.1143E+01	734.0	.4395E+00	735.0	-.5273E+00
+	736.0	-.1260E+01	737.0	-.1729E+01	738.0	-.1846E+01	739.0	-.1729E+01
+	740.0	-.1245E+01	741.0	-.5127E+00	742.0	.5420E+00	743.0	.1392E+01
122463	744.0	.2007E+01	745.0	.2124E+01	746.0	.1436E+01	747.0	.3369E+00
+	748.0	-.1230E+01	749.0	-.2637E+01	750.0	-.3413E+01	751.0	-.3398E+01

+	752.0	-.2681E+01	753.0	-.1230E+01	754.0	.5127E+00	755.0	.1875E+01
122464	756.0	.2578E+01	757.0	.2563E+01	758.0	.1641E+01	759.0	.2637E+00
+	760.0	-.1333E+01	761.0	-.2695E+01	762.0	-.3223E+01	763.0	-.2915E+01
+	764.0	-.1963E+01	765.0	-.6006E+00	766.0	.7617E+00	767.0	.1685E+01
122465	768.0	.2212E+01	769.0	.2227E+01	770.0	.1860E+01	771.0	.1260E+01
+	772.0	.6299E+00	773.0	-.4395E-01	774.0	-.6592E+00	775.0	-.1011E+01
+	776.0	-.1011E+01	777.0	-.5859E+00	778.0	.0000E+00	779.0	.5420E+00
122466	780.0	.7910E+00						
122500	781	* PITCH ANGLE (DEG)						
122501	.0	.1904E+00	1.0	.1904E+00	2.0	.3516E+00	3.0	.6152E+00
+	4.0	.7764E+00	5.0	.7617E+00	6.0	.7617E+00	7.0	.9229E+00
+	8.0	.1055E+01	9.0	.1084E+01	10.0	.8496E+00	11.0	.4980E+00
122502	12.0	.1025E+00	13.0	.1465E-01	14.0	.1904E+00	15.0	.7178E+00
+	16.0	.1260E+01	17.0	.1436E+01	18.0	.9961E+00	19.0	.4102E+00
+	20.0	.2197E+00	21.0	.3516E+00	22.0	.6006E+00	23.0	.7764E+00
122503	24.0	.7324E+00	25.0	.6885E+00	26.0	.4688E+00	27.0	.3955E+00
+	28.0	.3662E+00	29.0	.3516E+00	30.0	.5273E+00	31.0	.7178E+00
+	32.0	.6885E+00	33.0	.6885E+00	34.0	.6006E+00	35.0	.6006E+00
122504	36.0	.7617E+00	37.0	.1011E+01	38.0	.1099E+01	39.0	.1011E+01
+	40.0	.6738E+00	41.0	.3809E+00	42.0	.3516E+00	43.0	.3516E+00
+	44.0	.5127E+00	45.0	.5566E+00	46.0	.4980E+00	47.0	.4102E+00
122505	48.0	.3955E+00	49.0	.4395E+00	50.0	.6299E+00	51.0	.1099E+01
+	52.0	.1436E+01	53.0	.1187E+01	54.0	.7617E+00	55.0	.3076E+00
+	56.0	.3955E+00	57.0	.5273E+00	58.0	.5127E+00	59.0	.5127E+00
122506	60.0	.5273E+00	61.0	.6885E+00	62.0	.9082E+00	63.0	.1084E+01
+	64.0	.1172E+01	65.0	.1099E+01	66.0	.6152E+00	67.0	.2637E+00
+	68.0	-.1904E+00	69.0	-.5859E-01	70.0	.4980E+00	71.0	.1069E+01
122507	72.0	.1216E+01	73.0	.9814E+00	74.0	.6738E+00	75.0	.7617E+00
+	76.0	.1099E+01	77.0	.1187E+01	78.0	.9229E+00	79.0	.3662E+00
+	80.0	-.4395E-01	81.0	.2930E-01	82.0	.3662E+00	83.0	.4395E+00
122508	84.0	.2783E+00	85.0	.2637E+00	86.0	.5127E+00	87.0	.1099E+01
+	88.0	.1509E+01	89.0	.1421E+01	90.0	.1172E+01	91.0	.7471E+00
+	92.0	.5273E+00	93.0	.5273E+00	94.0	.3516E+00	95.0	-.4395E-01
122509	96.0	-.2197E+00	97.0	.5859E-01	98.0	.6885E+00	99.0	.1099E+01
+	100.0	.1084E+01	101.0	.9229E+00	102.0	.9375E+00	103.0	.1011E+01
+	104.0	.9375E+00	105.0	.5859E+00	106.0	.5127E+00	107.0	.7764E+00
122510	108.0	.1069E+01	109.0	.9229E+00	110.0	.5566E+00	111.0	.2637E+00
+	112.0	.3516E+00	113.0	.6738E+00	114.0	.7764E+00	115.0	.6738E+00
+	116.0	.5273E+00	117.0	.5273E+00	118.0	.6885E+00	119.0	.7617E+00
122511	120.0	.6299E+00	121.0	.6738E+00	122.0	.1011E+01	123.0	.1260E+01
+	124.0	.1289E+01	125.0	.1011E+01	126.0	.7324E+00	127.0	.5713E+00
+	128.0	.6738E+00	129.0	.5127E+00	130.0	.1758E+00	131.0	.1465E-01
122512	132.0	.1025E+00	133.0	.5420E+00	134.0	.8203E+00	135.0	.8496E+00
+	136.0	.5420E+00	137.0	.6885E+00	138.0	.8203E+00	139.0	.7764E+00
+	140.0	.6006E+00	141.0	.5273E+00	142.0	.7764E+00	143.0	.9229E+00
122513	144.0	.9082E+00	145.0	.5420E+00	146.0	.3516E+00	147.0	.4248E+00
+	148.0	.6885E+00	149.0	.7764E+00	150.0	.6152E+00	151.0	.5127E+00
+	152.0	.4248E+00	153.0	.7471E+00	154.0	.1084E+01	155.0	.1157E+01
122514	156.0	.7764E+00	157.0	.3076E+00	158.0	.3076E+00	159.0	.5127E+00
+	160.0	.6445E+00	161.0	.6006E+00	162.0	.3662E+00	163.0	.3516E+00
+	164.0	.5859E+00	165.0	.9375E+00	166.0	.1128E+01	167.0	.9229E+00
122515	168.0	.3955E+00	169.0	.1465E-01	170.0	.2930E-01	171.0	.5273E+00
+	172.0	.1011E+01	173.0	.1099E+01	174.0	.1011E+01	175.0	.8496E+00
+	176.0	.9229E+00	177.0	.1011E+01	178.0	.9229E+00	179.0	.4980E+00
122516	180.0	.1465E+00	181.0	.1465E-01	182.0	.4395E+00	183.0	.1011E+01
+	184.0	.1348E+01	185.0	.1318E+01	186.0	.1187E+01	187.0	.1113E+01
+	188.0	.1099E+01	189.0	.8496E+00	190.0	.4980E+00	191.0	.1904E+00
122517	192.0	.1465E+00	193.0	.1465E+00	194.0	.1025E+00	195.0	.1758E+00
+	196.0	.6006E+00	197.0	.1099E+01	198.0	.1421E+01	199.0	.1318E+01
+	200.0	.9375E+00	201.0	.5566E+00	202.0	.4395E+00	203.0	.2930E+00
122518	204.0	.2783E+00	205.0	.1904E+00	206.0	.1904E+00	207.0	.2783E+00
+	208.0	.3516E+00	209.0	.4980E+00	210.0	.9375E+00	211.0	.1406E+01
+	212.0	.1392E+01	213.0	.1025E+01	214.0	.6006E+00	215.0	.5273E+00
122519	216.0	.6592E+00	217.0	.8496E+00	218.0	.9229E+00	219.0	.6738E+00
+	220.0	.3516E+00	221.0	.2637E+00	222.0	.3516E+00	223.0	.6006E+00
+	224.0	.8496E+00	225.0	.1011E+01	226.0	.9229E+00	227.0	.6299E+00
122520	228.0	.7764E+00	229.0	.1099E+01	230.0	.1421E+01	231.0	.1421E+01
+	232.0	.1201E+01	233.0	.8496E+00	234.0	.5713E+00	235.0	.6885E+00
+	236.0	.8057E+00	237.0	.6592E+00	238.0	.3662E+00	239.0	.2930E-01
122521	240.0	.5859E-01	241.0	.6006E+00	242.0	.1011E+01	243.0	.9229E+00
+	244.0	.4541E+00	245.0	.5127E+00	246.0	.8496E+00	247.0	.1260E+01
+	248.0	.1157E+01	249.0	.8496E+00	250.0	.4834E+00	251.0	.3955E+00
122522	252.0	.5273E+00	253.0	.7617E+00	254.0	.7617E+00	255.0	.5127E+00
+	256.0	.1904E+00	257.0	.1025E+00	258.0	.4395E+00	259.0	.7764E+00
+	260.0	.7764E+00	261.0	.5859E+00	262.0	.6885E+00	263.0	.1187E+01
122523	264.0	.1509E+01	265.0	.1421E+01	266.0	.1143E+01	267.0	.6885E+00
+	268.0	.3662E+00	269.0	.3516E+00	270.0	.5273E+00	271.0	.6006E+00
+	272.0	.6152E+00	273.0	.5127E+00	274.0	.6006E+00	275.0	.8496E+00
122524	276.0	.8789E+00	277.0	.6592E+00	278.0	.3076E+00	279.0	.3076E+00
+	280.0	.3516E+00	281.0	.5127E+00	282.0	.6006E+00	283.0	.7617E+00

+	284.0	.1172E+01	285.0	.1523E+01	286.0	.1377E+01	287.0	.1099E+01
122525	288.0	.6885E+00	289.0	.3955E+00	290.0	.2637E+00	291.0	.1904E+00
+	292.0	-.4395E-01	293.0	-.2490E+00	294.0	-.2197E+00	295.0	.1025E+00
+	296.0	.4248E+00	297.0	.7617E+00	298.0	.1099E+01	299.0	.1450E+01
122526	300.0	.1597E+01	301.0	.1392E+01	302.0	.1084E+01	303.0	.7178E+00
+	304.0	.5127E+00	305.0	.3809E+00	306.0	.2344E+00	307.0	.2930E-01
+	308.0	.1465E-01	309.0	.3809E+00	310.0	.9229E+00	311.0	.1172E+01
122527	312.0	.1011E+01	313.0	.7764E+00	314.0	.6445E+00	315.0	.6885E+00
+	316.0	.3955E+00	317.0	.1172E+00	318.0	.1025E+00	319.0	.5420E+00
+	320.0	.1099E+01	321.0	.1333E+01	322.0	.1143E+01	323.0	.6885E+00
122528	324.0	.5127E+00	325.0	.5127E+00	326.0	.5273E+00	327.0	.3662E+00
+	328.0	.2930E-01	329.0	.2930E-01	330.0	.2930E+00	331.0	.6006E+00
+	332.0	.7764E+00	333.0	.6592E+00	334.0	.5859E+00	335.0	.7617E+00
122529	336.0	.1099E+01	337.0	.1187E+01	338.0	.1011E+01	339.0	.6592E+00
+	340.0	.5713E+00	341.0	.6885E+00	342.0	.6885E+00	343.0	.4395E+00
+	344.0	.2637E+00	345.0	.3369E+00	346.0	.6152E+00	347.0	.9229E+00
122530	348.0	.9229E+00	349.0	.7178E+00	350.0	.4688E+00	351.0	.5273E+00
+	352.0	.6006E+00	353.0	.6885E+00	354.0	.6885E+00	355.0	.4395E+00
+	356.0	.4395E+00	357.0	.6738E+00	358.0	.9229E+00	359.0	.9375E+00
122531	360.0	.9229E+00	361.0	.1172E+01	362.0	.1362E+01	363.0	.1172E+01
+	364.0	.6006E+00	365.0	.1904E+00	366.0	.1758E+00	367.0	.3516E+00
+	368.0	.5127E+00	369.0	.5273E+00	370.0	.3516E+00	371.0	.3662E+00
122532	372.0	.5127E+00	373.0	.7764E+00	374.0	.8936E+00	375.0	.1011E+01
+	376.0	.1099E+01	377.0	.1025E+01	378.0	.6738E+00	379.0	.3369E+00
+	380.0	.3516E+00	381.0	.5713E+00	382.0	.7910E+00	383.0	.9229E+00
122533	384.0	.8496E+00	385.0	.8496E+00	386.0	.1011E+01	387.0	.1099E+01
+	388.0	.8496E+00	389.0	.5127E+00	390.0	.1025E+00	391.0	-.2197E+00
+	392.0	-.4688E+00	393.0	-.3809E+00	394.0	.2930E-01	395.0	.6152E+00
122534	396.0	.1099E+01	397.0	.1406E+01	398.0	.1509E+01	399.0	.1670E+01
+	400.0	.1685E+01	401.0	.1597E+01	402.0	.1392E+01	403.0	.1348E+01
+	404.0	.1011E+01	405.0	.5273E+00	406.0	.8789E-01	407.0	.2930E-01
122535	408.0	.2051E+00	409.0	.3516E+00	410.0	.2637E+00	411.0	.1904E+00
+	412.0	.3516E+00	413.0	.7617E+00	414.0	.1187E+01	415.0	.1421E+01
+	416.0	.1406E+01	417.0	.1260E+01	418.0	.1099E+01	419.0	.8350E+00
122536	420.0	.6738E+00	421.0	.6006E+00	422.0	.5859E+00	423.0	.7764E+00
+	424.0	.9375E+00	425.0	.7617E+00	426.0	.4395E+00	427.0	.2783E+00
+	428.0	.4541E+00	429.0	.8057E+00	430.0	.8496E+00	431.0	.5273E+00
122537	432.0	.2783E+00	433.0	.2783E+00	434.0	.6006E+00	435.0	.7764E+00
+	436.0	.7764E+00	437.0	.9375E+00	438.0	.1333E+01	439.0	.1523E+01
+	440.0	.1333E+01	441.0	.8496E+00	442.0	.6738E+00	443.0	.7031E+00
122538	444.0	.8350E+00	445.0	.6738E+00	446.0	.3516E+00	447.0	.1465E-01
+	448.0	-.1318E+00	449.0	.2930E-01	450.0	.4102E+00	451.0	.9082E+00
+	452.0	.1245E+01	453.0	.1348E+01	454.0	.1333E+01	455.0	.1274E+01
122539	456.0	.1187E+01	457.0	.1011E+01	458.0	.6885E+00	459.0	.4395E+00
+	460.0	.5127E+00	461.0	.6885E+00	462.0	.7910E+00	463.0	.6445E+00
+	464.0	.6152E+00	465.0	.5127E+00	466.0	.5127E+00	467.0	.6152E+00
122540	468.0	.6152E+00	469.0	.6006E+00	470.0	.5127E+00	471.0	.5566E+00
+	472.0	.7764E+00	473.0	.1025E+01	474.0	.1245E+01	475.0	.1348E+01
+	476.0	.1348E+01	477.0	.1069E+01	478.0	.7471E+00	479.0	.5127E+00
122541	480.0	.3516E+00	481.0	.3662E+00	482.0	.3662E+00	483.0	.6592E+00
+	484.0	.8203E+00	485.0	.8496E+00	486.0	.6445E+00	487.0	.4980E+00
+	488.0	.5127E+00	489.0	.7764E+00	490.0	.9375E+00	491.0	.9229E+00
122542	492.0	.8350E+00	493.0	.8203E+00	494.0	.1011E+01	495.0	.1157E+01
+	496.0	.1128E+01	497.0	.9521E+00	498.0	.6885E+00	499.0	.3516E+00
+	500.0	.1904E+00	501.0	.1758E+00	502.0	.4395E+00	503.0	.5566E+00
122543	504.0	.5127E+00	505.0	.5273E+00	506.0	.8203E+00	507.0	.1099E+01
+	508.0	.1011E+01	509.0	.4541E+00	510.0	.2930E-01	511.0	.1904E+00
+	512.0	.7617E+00	513.0	.1011E+01	514.0	.7910E+00	515.0	.4395E+00
122544	516.0	.3516E+00	517.0	.6006E+00	518.0	.9229E+00	519.0	.1011E+01
+	520.0	.9229E+00	521.0	.6738E+00	522.0	.4980E+00	523.0	.4541E+00
+	524.0	.3955E+00	525.0	.1904E+00	526.0	-.5859E-01	527.0	-.1025E+00
122545	528.0	.1904E+00	529.0	.6006E+00	530.0	.9375E+00	531.0	.1084E+01
+	532.0	.1040E+01	533.0	.9229E+00	534.0	.7617E+00	535.0	.8350E+00
+	536.0	.1099E+01	537.0	.1260E+01	538.0	.1143E+01	539.0	.6006E+00
122546	540.0	.1025E+00	541.0	.4395E-01	542.0	.2783E+00	543.0	.4248E+00
+	544.0	.5273E+00	545.0	.5127E+00	546.0	.6006E+00	547.0	.7617E+00
+	548.0	.8643E+00	549.0	.8496E+00	550.0	.7617E+00	551.0	.6152E+00
122547	552.0	.5273E+00	553.0	.6006E+00	554.0	.8496E+00	555.0	.1011E+01
+	556.0	.9229E+00	557.0	.6006E+00	558.0	.6885E+00	559.0	.1011E+01
+	560.0	.1099E+01	561.0	.7324E+00	562.0	.2783E+00	563.0	.7324E-01
122548	564.0	.2783E+00	565.0	.7617E+00	566.0	.1099E+01	567.0	.1025E+01
+	568.0	.6885E+00	569.0	.6738E+00	570.0	.1084E+01	571.0	.1348E+01
+	572.0	.1348E+01	573.0	.1333E+01	574.0	.1216E+01	575.0	.8350E+00
122549	576.0	.2637E+00	577.0	-.4395E-01	578.0	.2930E-01	579.0	.1904E+00
+	580.0	.2490E+00	581.0	.3223E+00	582.0	.5273E+00	583.0	.7617E+00
+	584.0	.1084E+01	585.0	.1216E+01	586.0	.1099E+01	587.0	.8496E+00
122550	588.0	.6885E+00	589.0	.7617E+00	590.0	.7617E+00	591.0	.3809E+00
+	592.0	.0000E+00	593.0	-.4395E-01	594.0	.4395E+00	595.0	.8350E+00
+	596.0	.7471E+00	597.0	.4834E+00	598.0	.3662E+00	599.0	.6885E+00
122551	600.0	.1099E+01	601.0	.1099E+01	602.0	.9229E+00	603.0	.7324E+00

+	604.0	.7764E+00	605.0	.7617E+00	606.0	.7471E+00	607.0	.6738E+00
+	608.0	.6006E+00	609.0	.3809E+00	610.0	.2637E+00	611.0	.2637E+00
122552	612.0	.3662E+00	613.0	.5127E+00	614.0	.6152E+00	615.0	.6006E+00
+	616.0	.6885E+00	617.0	.7764E+00	618.0	.8350E+00	619.0	.8496E+00
+	620.0	.8496E+00	621.0	.8496E+00	622.0	.7617E+00	623.0	.6299E+00
122553	624.0	.5127E+00	625.0	.6006E+00	626.0	.7617E+00	627.0	.6592E+00
+	628.0	.3662E+00	629.0	.3516E+00	630.0	.4248E+00	631.0	.4688E+00
+	632.0	.3809E+00	633.0	.3516E+00	634.0	.3516E+00	635.0	.6006E+00
122554	636.0	.9229E+00	637.0	.1172E+01	638.0	.1187E+01	639.0	.9229E+00
+	640.0	.7471E+00	641.0	.8496E+00	642.0	.1113E+01	643.0	.1187E+01
+	644.0	.8496E+00	645.0	.3662E+00	646.0	.1172E+00	647.0	.3516E+00
122555	648.0	.6885E+00	649.0	.7764E+00	650.0	.6006E+00	651.0	.3223E+00
+	652.0	.1025E+00	653.0	.1904E+00	654.0	.4395E+00	655.0	.7617E+00
+	656.0	.1011E+01	657.0	.1172E+01	658.0	.1113E+01	659.0	.1099E+01
122556	660.0	.1245E+01	661.0	.1494E+01	662.0	.1597E+01	663.0	.1128E+01
+	664.0	.3516E+00	665.0	-.1611E+00	666.0	-.2197E+00	667.0	-.1318E+00
+	668.0	.2930E-01	669.0	.8789E-01	670.0	.3516E+00	671.0	.1011E+01
122557	672.0	.1670E+01	673.0	.1919E+01	674.0	.1465E+01	675.0	.7324E+00
+	676.0	.3662E+00	677.0	.3516E+00	678.0	.5273E+00	679.0	.3516E+00
+	680.0	.1904E+00	681.0	.2051E+00	682.0	.5127E+00	683.0	.6006E+00
122558	684.0	.4102E+00	685.0	.3516E+00	686.0	.5127E+00	687.0	.8643E+00
+	688.0	.1011E+01	689.0	.9375E+00	690.0	.7617E+00	691.0	.8203E+00
+	692.0	.1187E+01	693.0	.1406E+01	694.0	.1157E+01	695.0	.6738E+00
122559	696.0	.3516E+00	697.0	.4395E+00	698.0	.6152E+00	699.0	.5127E+00
+	700.0	.2930E-01	701.0	-.3076E+00	702.0	-.1611E+00	703.0	.5127E+00
+	704.0	.1172E+01	705.0	.1348E+01	706.0	.1099E+01	707.0	.6006E+00
122560	708.0	.5127E+00	709.0	.9375E+00	710.0	.1348E+01	711.0	.1201E+01
+	712.0	.6445E+00	713.0	.1904E+00	714.0	.2197E+00	715.0	.6885E+00
+	716.0	.7764E+00	717.0	.3662E+00	718.0	.1758E+00	719.0	.5127E+00
122561	720.0	.1172E+01	721.0	.1348E+01	722.0	.1011E+01	723.0	.6006E+00
+	724.0	.8496E+00	725.0	.1187E+01	726.0	.1128E+01	727.0	.6592E+00
+	728.0	.2783E+00	729.0	.2637E+00	730.0	.5273E+00	731.0	.5273E+00
122562	732.0	.3516E+00	733.0	.3516E+00	734.0	.5127E+00	735.0	.7178E+00
+	736.0	.7764E+00	737.0	.9229E+00	738.0	.1187E+01	739.0	.1348E+01
+	740.0	.1172E+01	741.0	.7764E+00	742.0	.3369E+00	743.0	.1904E+00
122563	744.0	.3662E+00	745.0	.6738E+00	746.0	.7617E+00	747.0	.5127E+00
+	748.0	.2783E+00	749.0	.3662E+00	750.0	.7617E+00	751.0	.9375E+00
+	752.0	.8350E+00	753.0	.6738E+00	754.0	.5127E+00	755.0	.3369E+00
122564	756.0	.3516E+00	757.0	.6738E+00	758.0	.1099E+01	759.0	.1216E+01
+	760.0	.1128E+01	761.0	.1055E+01	762.0	.9961E+00	763.0	.6006E+00
+	764.0	.1172E+00	765.0	.1465E-01	766.0	.3516E+00	767.0	.6738E+00
122565	768.0	.6885E+00	769.0	.5127E+00	770.0	.3516E+00	771.0	.5273E+00
+	772.0	.9229E+00	773.0	.1172E+01	774.0	.1099E+01	775.0	.7617E+00
+	776.0	.6006E+00	777.0	.6885E+00	778.0	.8203E+00	779.0	.7031E+00
122566	780.0	.3955E+00						
122600	781	* YAW ANGULAR VELOCITY (DEG/S)						
122601	.0	.8301E-01	1.0	.1953E+00	2.0	.2539E+00	3.0	.2295E+00
+	4.0	.1270E+00	5.0	-.2441E-01	6.0	-.1465E+00	7.0	-.3271E+00
+	8.0	-.4688E+00	9.0	-.5127E+00	10.0	-.4248E+00	11.0	-.1563E+00
122602	12.0	.2588E+00	13.0	.4688E+00	14.0	.3613E+00	15.0	.1953E+00
+	16.0	.1611E+00	17.0	.1904E+00	18.0	.1318E+00	19.0	.5371E-01
+	20.0	.1025E+00	21.0	.1514E+00	22.0	.7813E-01	23.0	-.8301E-01
122603	24.0	-.2148E+00	25.0	-.1953E+00	26.0	-.9277E-01	27.0	.9766E-02
+	28.0	.1660E+00	29.0	.3516E+00	30.0	.4883E+00	31.0	.4248E+00
+	32.0	.2441E+00	33.0	.2930E-01	34.0	-.1953E+00	35.0	-.2441E+00
122604	36.0	-.1465E+00	37.0	-.7324E-01	38.0	.5371E-01	39.0	.1758E+00
+	40.0	.2197E+00	41.0	.7324E-01	42.0	-.2051E+00	43.0	-.4150E+00
+	44.0	-.5371E+00	45.0	-.5762E+00	46.0	-.5078E+00	47.0	-.2881E+00
122605	48.0	-.5859E-01	49.0	.1416E+00	50.0	.1807E+00	51.0	.3906E-01
+	52.0	-.1074E+00	53.0	-.2441E+00	54.0	-.3125E+00	55.0	-.3223E+00
+	56.0	-.4053E+00	57.0	-.4443E+00	58.0	-.3809E+00	59.0	-.2441E+00
122606	60.0	-.1221E+00	61.0	-.1025E+00	62.0	-.6836E-01	63.0	-.9766E-02
+	64.0	-.4395E-01	65.0	-.1221E+00	66.0	-.2002E+00	67.0	-.3320E+00
+	68.0	-.5127E+00	69.0	-.5322E+00	70.0	-.4102E+00	71.0	-.2197E+00
122607	72.0	-.9277E-01	73.0	-.3906E-01	74.0	-.4883E-02	75.0	.4883E-01
+	76.0	.1172E+00	77.0	.1709E+00	78.0	.2393E+00	79.0	.3125E+00
+	80.0	.2441E+00	81.0	-.6836E-01	82.0	-.3857E+00	83.0	-.5029E+00
122608	84.0	-.4004E+00	85.0	-.2490E+00	86.0	-.1221E+00	87.0	.8789E-01
+	88.0	.3076E+00	89.0	.4248E+00	90.0	.3076E+00	91.0	.1074E+00
+	92.0	.2441E-01	93.0	.4395E-01	94.0	-.4883E-02	95.0	-.1025E+00
122609	96.0	-.1270E+00	97.0	-.6348E-01	98.0	.0000E+00	99.0	.6836E-01
+	100.0	.1904E+00	101.0	.3271E+00	102.0	.3613E+00	103.0	.3369E+00
+	104.0	.2686E+00	105.0	.6348E-01	106.0	-.6348E-01	107.0	-.1025E+00
122610	108.0	-.1318E+00	109.0	-.2637E+00	110.0	-.3027E+00	111.0	-.1221E+00
+	112.0	.8301E-01	113.0	.2344E+00	114.0	.2490E+00	115.0	.2100E+00
+	116.0	.1807E+00	117.0	.1855E+00	118.0	.2148E+00	119.0	.2197E+00
122611	120.0	.2490E+00	121.0	.3027E+00	122.0	.2441E+00	123.0	-.1953E-01
+	124.0	-.3027E+00	125.0	-.4053E+00	126.0	-.3857E+00	127.0	-.3369E+00
+	128.0	-.2783E+00	129.0	-.1953E+00	130.0	-.1367E+00	131.0	-.6836E-01
122612	132.0	-.9766E-02	133.0	.1953E-01	134.0	-.1172E+00	135.0	-.2246E+00

+	136.0	-.1172E+00	137.0	-.5371E-01	138.0	-.1465E+00	139.0	-.2002E+00
+	140.0	-.1123E+00	141.0	-.1172E+00	142.0	-.2686E+00	143.0	-.4346E+00
122613	144.0	-.5127E+00	145.0	-.5518E+00	146.0	-.5420E+00	147.0	-.4492E+00
+	148.0	-.2002E+00	149.0	.8789E-01	150.0	.2197E+00	151.0	.1904E+00
+	152.0	.6836E-01	153.0	.5371E-01	154.0	.8301E-01	155.0	.3418E-01
122614	156.0	-.1465E+00	157.0	-.3711E+00	158.0	-.4834E+00	159.0	-.2783E+00
+	160.0	.1074E+00	161.0	.3955E+00	162.0	.3857E+00	163.0	.2295E+00
+	164.0	.6348E-01	165.0	-.1221E+00	166.0	-.2539E+00	167.0	-.2490E+00
122615	168.0	-.1318E+00	169.0	.4395E-01	170.0	.1758E+00	171.0	.2881E+00
+	172.0	.3955E+00	173.0	.3809E+00	174.0	.2148E+00	175.0	.4883E-01
+	176.0	-.4395E-01	177.0	.1465E-01	178.0	.1514E+00	179.0	.2246E+00
122616	180.0	.1318E+00	181.0	-.1465E-01	182.0	-.6836E-01	183.0	-.1465E-01
+	184.0	.2441E-01	185.0	.9766E-01	186.0	.1611E+00	187.0	.1709E+00
+	188.0	.2100E+00	189.0	.2344E+00	190.0	.1318E+00	191.0	-.1465E-01
122617	192.0	-.1123E+00	193.0	-.2393E+00	194.0	-.2832E+00	195.0	-.2588E+00
+	196.0	-.2100E+00	197.0	-.1855E+00	198.0	-.1514E+00	199.0	-.1563E+00
+	200.0	-.2002E+00	201.0	-.2393E+00	202.0	-.1807E+00	203.0	-.1221E+00
122618	204.0	-.1416E+00	205.0	-.2197E+00	206.0	-.2148E+00	207.0	-.2100E+00
+	208.0	-.2588E+00	209.0	-.3516E+00	210.0	-.3711E+00	211.0	-.2100E+00
+	212.0	-.5371E-01	213.0	.1465E-01	214.0	-.9766E-02	215.0	-.1514E+00
122619	216.0	-.3516E+00	217.0	-.4395E+00	218.0	-.3711E+00	219.0	-.2881E+00
+	220.0	-.2686E+00	221.0	-.1416E+00	222.0	.0000E+00	223.0	.9277E-01
+	224.0	.8789E-01	225.0	-.2930E-01	226.0	-.2051E+00	227.0	-.2734E+00
122620	228.0	-.2051E+00	229.0	.1465E-01	230.0	.1758E+00	231.0	.1807E+00
+	232.0	.1074E+00	233.0	.0000E+00	234.0	-.1318E+00	235.0	-.1660E+00
+	236.0	-.2051E+00	237.0	-.2881E+00	238.0	-.2002E+00	239.0	.6836E-01
122621	240.0	.2490E+00	241.0	.2832E+00	242.0	.2783E+00	243.0	.2148E+00
+	244.0	.1025E+00	245.0	-.4883E-02	246.0	-.4883E-02	247.0	.1318E+00
+	248.0	.3174E+00	249.0	.4248E+00	250.0	.4102E+00	251.0	.2734E+00
122622	252.0	.1367E+00	253.0	.1025E+00	254.0	.4883E-01	255.0	-.3906E-01
+	256.0	-.6348E-01	257.0	-.5371E-01	258.0	-.8789E-01	259.0	-.1123E+00
+	260.0	-.8789E-01	261.0	-.9766E-02	262.0	.4883E-02	263.0	.0000E+00
122623	264.0	.1123E+00	265.0	.2832E+00	266.0	.3271E+00	267.0	.2588E+00
+	268.0	.1416E+00	269.0	.1172E+00	270.0	.4395E-01	271.0	-.7813E-01
+	272.0	-.2002E+00	273.0	-.3564E+00	274.0	-.4297E+00	275.0	-.3320E+00
122624	276.0	-.2148E+00	277.0	-.7813E-01	278.0	.1025E+00	279.0	.2588E+00
+	280.0	.2295E+00	281.0	.5371E-01	282.0	-.8789E-01	283.0	-.1953E+00
+	284.0	-.3125E+00	285.0	-.3711E+00	286.0	-.3125E+00	287.0	-.1758E+00
122625	288.0	-.1025E+00	289.0	-.1221E+00	290.0	-.1074E+00	291.0	-.9277E-01
+	292.0	-.1123E+00	293.0	-.1660E+00	294.0	-.2588E+00	295.0	-.4639E+00
+	296.0	-.5957E+00	297.0	-.5615E+00	298.0	-.3857E+00	299.0	-.1221E+00
122626	300.0	.4395E-01	301.0	.1318E+00	302.0	.2197E+00	303.0	.2148E+00
+	304.0	.6348E-01	305.0	-.1074E+00	306.0	-.1416E+00	307.0	-.2246E+00
+	308.0	-.3955E+00	309.0	-.5078E+00	310.0	-.4785E+00	311.0	-.4590E+00
122627	312.0	-.4590E+00	313.0	-.3662E+00	314.0	-.2441E+00	315.0	-.1123E+00
+	316.0	.4395E-01	317.0	.2148E+00	318.0	.3271E+00	319.0	.2881E+00
+	320.0	.1318E+00	321.0	.5371E-01	322.0	.9277E-01	323.0	.6348E-01
122628	324.0	-.7813E-01	325.0	-.2490E+00	326.0	-.3027E+00	327.0	-.1611E+00
+	328.0	.5371E-01	329.0	.2148E+00	330.0	.2637E+00	331.0	.3076E+00
+	332.0	.3418E+00	333.0	.2881E+00	334.0	.1074E+00	335.0	-.3906E-01
122629	336.0	-.3906E-01	337.0	.0000E+00	338.0	-.1465E-01	339.0	-.5371E-01
+	340.0	.4883E-02	341.0	.1172E+00	342.0	.1465E+00	343.0	.1123E+00
+	344.0	.1514E+00	345.0	.3027E+00	346.0	.4541E+00	347.0	.4541E+00
122630	348.0	.2734E+00	349.0	.7324E-01	350.0	-.1270E+00	351.0	-.2979E+00
+	352.0	-.3369E+00	353.0	-.3467E+00	354.0	-.2686E+00	355.0	-.1611E+00
+	356.0	-.9766E-01	357.0	-.8301E-01	358.0	-.3906E-01	359.0	-.9277E-01
122631	360.0	-.2393E+00	361.0	-.2148E+00	362.0	-.9766E-01	363.0	-.4883E-01
+	364.0	-.4395E-01	365.0	.9277E-01	366.0	.2148E+00	367.0	.1172E+00
+	368.0	-.1563E+00	369.0	-.4150E+00	370.0	-.5615E+00	371.0	-.5273E+00
122632	372.0	-.4248E+00	373.0	-.3906E+00	374.0	-.3662E+00	375.0	-.3564E+00
+	376.0	-.3223E+00	377.0	-.2393E+00	378.0	-.1855E+00	379.0	-.1904E+00
+	380.0	-.1563E+00	381.0	-.1025E+00	382.0	-.5371E-01	383.0	-.9766E-02
122633	384.0	.1465E-01	385.0	-.2930E-01	386.0	-.1367E+00	387.0	-.3076E+00
+	388.0	-.3955E+00	389.0	-.3271E+00	390.0	-.1221E+00	391.0	.1025E+00
+	392.0	.2002E+00	393.0	.1221E+00	394.0	.0000E+00	395.0	-.3906E-01
122634	396.0	-.9766E-01	397.0	-.2393E+00	398.0	-.2783E+00	399.0	-.2295E+00
+	400.0	-.1904E+00	401.0	-.6836E-01	402.0	.9766E-02	403.0	.4395E-01
+	404.0	.5371E-01	405.0	.1416E+00	406.0	.2588E+00	407.0	.3418E+00
122635	408.0	.3320E+00	409.0	.2832E+00	410.0	.2002E+00	411.0	.1514E+00
+	412.0	.2100E+00	413.0	.2393E+00	414.0	.1221E+00	415.0	-.8301E-01
+	416.0	-.1367E+00	417.0	-.3906E-01	418.0	-.5371E-01	419.0	-.9766E-01
122636	420.0	-.4395E-01	421.0	.8301E-01	422.0	.1807E+00	423.0	.2686E+00
+	424.0	.2734E+00	425.0	.2148E+00	426.0	.2051E+00	427.0	.2881E+00
+	428.0	.3271E+00	429.0	.3027E+00	430.0	.2637E+00	431.0	.2002E+00
122637	432.0	.1123E+00	433.0	.6836E-01	434.0	-.1318E+00	435.0	-.2979E+00
+	436.0	-.3809E+00	437.0	-.3760E+00	438.0	-.3809E+00	439.0	-.2979E+00
+	440.0	-.3418E-01	441.0	.2686E+00	442.0	.3613E+00	443.0	.2637E+00
122638	444.0	.1123E+00	445.0	.4883E-02	446.0	.1953E-01	447.0	.5859E-01
+	448.0	-.1123E+00	449.0	-.3613E+00	450.0	-.4150E+00	451.0	-.2588E+00
+	452.0	-.2002E+00	453.0	-.2930E+00	454.0	-.4150E+00	455.0	-.4883E+00

122639	456.0	-.3955E+00	457.0	-.2393E+00	458.0	-.2246E+00	459.0	-.2246E+00
+	460.0	-.7324E-01	461.0	.8789E-01	462.0	.1514E+00	463.0	.1123E+00
+	464.0	-.7324E-01	465.0	-.3076E+00	466.0	-.4346E+00	467.0	-.3662E+00
122640	468.0	-.2246E+00	469.0	-.1514E+00	470.0	-.1416E+00	471.0	-.1904E+00
+	472.0	-.2295E+00	473.0	-.1660E+00	474.0	-.6348E-01	475.0	.4395E-01
+	476.0	.5371E-01	477.0	.3906E-01	478.0	.1172E+00	470.0	.1660E+00
122641	480.0	.1123E+00	481.0	-.1953E-01	482.0	-.1758E+00	483.0	-.2539E+00
+	484.0	-.2832E+00	485.0	-.2344E+00	486.0	-.1611E+00	487.0	-.4395E-01
+	488.0	.1172E+00	489.0	.2686E+00	490.0	.3418E+00	491.0	.3125E+00
122642	492.0	.2393E+00	493.0	.2148E+00	494.0	.1172E+00	495.0	-.3418E-01
+	496.0	-.1855E+00	497.0	-.3076E+00	498.0	-.4492E+00	499.0	-.5127E+00
+	500.0	-.4053E+00	501.0	-.7813E-01	502.0	.2100E+00	503.0	.3027E+00
122643	504.0	.3760E+00	505.0	.4590E+00	506.0	.5029E+00	507.0	.4199E+00
+	508.0	.1807E+00	509.0	.1465E-01	510.0	-.5371E-01	511.0	-.9766E-01
+	512.0	-.1123E+00	513.0	-.1660E+00	514.0	-.2490E+00	515.0	-.3613E+00
122644	516.0	-.4688E+00	517.0	-.4688E+00	518.0	-.3564E+00	519.0	-.1807E+00
+	520.0	-.1465E-01	521.0	.7813E-01	522.0	.1855E+00	523.0	.3076E+00
+	524.0	.3369E+00	525.0	.3125E+00	526.0	.2295E+00	527.0	-.2930E-01
122645	528.0	-.3223E+00	529.0	-.6250E+00	530.0	-.8252E+00	531.0	-.7861E+00
+	532.0	-.5713E+00	533.0	-.3271E+00	534.0	.3418E-01	535.0	.4590E+00
+	536.0	.6299E+00	537.0	.4639E+00	538.0	.1318E+00	539.0	-.1416E+00
122646	540.0	-.2783E+00	541.0	-.4102E+00	542.0	-.4932E+00	543.0	-.4785E+00
+	544.0	-.3027E+00	545.0	.0000E+00	546.0	.1904E+00	547.0	.1367E+00
+	548.0	.4395E-01	549.0	.4883E-01	550.0	.4883E-01	551.0	.6348E-01
122647	552.0	-.2930E-01	553.0	-.1855E+00	554.0	-.1465E+00	555.0	-.2441E-01
+	556.0	.8301E-01	557.0	.1172E+00	558.0	.1514E+00	559.0	.1025E+00
+	560.0	.8789E-01	561.0	.1953E-01	562.0	-.6836E-01	563.0	-.1709E+00
122648	564.0	-.2051E+00	565.0	-.1123E+00	566.0	.5371E-01	567.0	.1416E+00
+	568.0	.1709E+00	569.0	.3076E+00	570.0	.4443E+00	571.0	.3955E+00
+	572.0	.2588E+00	573.0	.1514E+00	574.0	.6836E-01	575.0	-.5371E-01
122649	576.0	-.1660E+00	577.0	-.2490E+00	578.0	-.3027E+00	579.0	-.2002E+00
+	580.0	-.3418E-01	581.0	.3906E-01	582.0	.1465E-01	583.0	-.6348E-01
+	584.0	-.7813E-01	585.0	.0000E+00	586.0	.1025E+00	587.0	.1416E+00
122650	588.0	.1904E+00	589.0	.2783E+00	590.0	.3125E+00	591.0	.1563E+00
+	592.0	-.5859E-01	593.0	-.2002E+00	594.0	-.3564E+00	595.0	-.5273E+00
+	596.0	-.5469E+00	597.0	-.5029E+00	598.0	-.5811E+00	599.0	-.5908E+00
122651	600.0	-.3467E+00	601.0	.6348E-01	602.0	.3516E+00	603.0	.3369E+00
+	604.0	.2734E+00	605.0	.2393E+00	606.0	.1514E+00	607.0	.2441E-01
+	608.0	-.1904E+00	609.0	-.4004E+00	610.0	-.5273E+00	611.0	-.5176E+00
122652	612.0	-.4199E+00	613.0	-.3662E+00	614.0	-.2637E+00	615.0	-.1953E-01
+	616.0	.2100E+00	617.0	.1123E+00	618.0	-.7813E-01	619.0	-.1367E+00
+	620.0	-.1953E-01	621.0	.3906E-01	622.0	-.5371E-01	623.0	-.2002E+00
122653	624.0	-.2637E+00	625.0	-.1270E+00	626.0	.3418E-01	627.0	.1904E+00
+	628.0	.2979E+00	629.0	.2197E+00	630.0	.1953E-01	631.0	-.9277E-01
+	632.0	-.1807E+00	633.0	-.1904E+00	634.0	-.1367E+00	635.0	-.6348E-01
122654	636.0	-.5371E-01	637.0	-.4883E-01	638.0	-.6836E-01	639.0	-.1563E+00
+	640.0	-.1855E+00	641.0	-.6348E-01	642.0	.1318E+00	643.0	.3564E+00
+	644.0	.5078E+00	645.0	.4590E+00	646.0	.2783E+00	647.0	.6836E-01
122655	648.0	-.8301E-01	649.0	-.1611E+00	650.0	-.1758E+00	651.0	-.1855E+00
+	652.0	-.2393E+00	653.0	-.2686E+00	654.0	-.2100E+00	655.0	-.1318E+00
+	656.0	-.5371E-01	657.0	.1465E-01	658.0	.8789E-01	659.0	.2393E+00
122656	660.0	.2783E+00	661.0	.1855E+00	662.0	.5371E-01	663.0	-.4395E-01
+	664.0	-.5859E-01	665.0	.0000E+00	666.0	-.1465E-01	667.0	-.8301E-01
+	668.0	-.1172E+00	669.0	-.1367E+00	670.0	-.2979E+00	671.0	-.5078E+00
122657	672.0	-.5176E+00	673.0	-.3564E+00	674.0	-.1611E+00	675.0	.2441E-01
+	676.0	.9277E-01	677.0	.7813E-01	678.0	.1367E+00	679.0	.2881E+00
+	680.0	.2490E+00	681.0	.4883E-02	682.0	-.3027E+00	683.0	-.5273E+00
122658	684.0	-.5273E+00	685.0	-.3125E+00	686.0	-.2441E-01	687.0	.2100E+00
+	688.0	.2246E+00	689.0	.8789E-01	690.0	-.3418E-01	691.0	-.1025E+00
+	692.0	-.1465E+00	693.0	-.1904E+00	694.0	-.2490E+00	695.0	-.3613E+00
122659	696.0	-.3418E+00	697.0	-.1172E+00	698.0	.2295E+00	699.0	.5176E+00
+	700.0	.4883E+00	701.0	.2344E+00	702.0	-.2930E-01	703.0	-.2588E+00
+	704.0	-.3418E+00	705.0	-.2832E+00	706.0	-.1465E+00	707.0	-.5859E-01
122660	708.0	-.4883E-01	709.0	.0000E+00	710.0	.1318E+00	711.0	.3174E+00
+	712.0	.3369E+00	713.0	.2100E+00	714.0	.3418E-01	715.0	-.6348E-01
+	716.0	-.8789E-01	717.0	-.1416E+00	718.0	-.2344E+00	719.0	-.2002E+00
122661	720.0	-.1465E-01	721.0	.1465E+00	722.0	.1953E+00	723.0	.2051E+00
+	724.0	.2686E+00	725.0	.3662E+00	726.0	.3955E+00	727.0	.3516E+00
+	728.0	.1611E+00	729.0	-.4883E-01	730.0	-.2441E+00	731.0	-.3955E+00
122662	732.0	-.3955E+00	733.0	-.3271E+00	734.0	-.3271E+00	735.0	-.3369E+00
+	736.0	-.2100E+00	737.0	-.4883E-02	738.0	.1709E+00	739.0	.2930E+00
+	740.0	.2783E+00	741.0	.2441E+00	742.0	.2100E+00	743.0	.7813E-01
122663	744.0	-.1563E+00	745.0	-.3271E+00	746.0	-.3467E+00	747.0	-.3027E+00
+	748.0	-.3564E+00	749.0	-.3662E+00	750.0	-.3516E+00	751.0	-.2588E+00
+	752.0	-.1660E+00	753.0	-.3418E-01	754.0	.2295E+00	755.0	.3320E+00
122664	756.0	.2197E+00	757.0	.1953E-01	758.0	-.1807E+00	759.0	-.3418E+00
+	760.0	-.3271E+00	761.0	-.2637E+00	762.0	-.2441E+00	763.0	-.2588E+00
+	764.0	-.2295E+00	765.0	-.1514E+00	766.0	-.1074E+00	767.0	-.7813E-01
122665	768.0	-.5859E-01	769.0	-.4395E-01	770.0	-.1563E+00	771.0	-.3418E+00
+	772.0	-.3809E+00	773.0	-.2734E+00	774.0	-.2295E+00	775.0	-.2148E+00

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+         776.0 -.1660E+00  777.0 -.1660E+00  778.0 -.1074E+00  779.0 -.3418E-01
 122666   780.0 -.7813E-01
 122700 781      * RIGHT AND LEFT ACCELERATION (G)
 122701      .0 -.1465E-01    1.0 -.8789E-02    2.0  .2441E-02    3.0  .1416E-01
+           4.0  .1855E-01    5.0  .1123E-01    6.0  .4883E-03    7.0 -.3906E-02
+           8.0 -.5859E-02    9.0 -.5859E-02   10.0 -.5859E-02   11.0 -.7324E-02
 122702    12.0 -.4883E-03   13.0  .1172E-01   14.0  .1514E-01   15.0  .4883E-02
+          16.0 -.1953E-02   17.0  .0000E+00   18.0  .4883E-02   19.0  .6348E-02
+          20.0  .3906E-02   21.0  .2441E-02   22.0 -.7813E-02   23.0 -.1465E-01
 122703    24.0 -.1563E-01   25.0 -.8789E-02   26.0  .4883E-02   27.0  .1563E-01
+          28.0  .1758E-01   29.0  .1025E-01   30.0 -.7813E-02   31.0 -.1416E-01
+          32.0 -.1367E-01   33.0 -.1074E-01   34.0 -.9766E-03   35.0  .7324E-02
 122704    36.0  .1025E-01   37.0  .3418E-02   38.0 -.9766E-02   39.0 -.9766E-02
+          40.0 -.1465E-02   41.0  .7813E-02   42.0  .9766E-02   43.0  .6836E-02
+          44.0 -.4883E-03   45.0 -.6836E-02   46.0 -.1172E-01   47.0 -.1465E-01
 122705    48.0 -.8301E-02   49.0 -.7813E-02   50.0 -.1514E-01   51.0 -.8301E-02
+          52.0  .1270E-01   53.0  .2539E-01   54.0  .2686E-01   55.0  .1953E-01
+          56.0  .4883E-03   57.0 -.2344E-01   58.0 -.3809E-01   59.0 -.2441E-01
 122706    60.0  .4883E-02   61.0  .1563E-01   62.0  .1221E-01   63.0 -.1465E-02
+          64.0 -.3418E-02   65.0  .6836E-02   66.0  .1123E-01   67.0  .7324E-02
+          68.0 -.7813E-02   69.0 -.2344E-01   70.0 -.2100E-01   71.0 -.7324E-02
 122707    72.0  .5859E-02   73.0  .7813E-02   74.0  .6836E-02   75.0 -.3418E-02
+          76.0 -.9766E-02   77.0 -.1367E-01   78.0 -.1514E-01   79.0 -.2930E-02
+          80.0  .1416E-01   81.0  .1318E-01   82.0  .1074E-01   83.0  .4395E-02
 122708    84.0  .1953E-02   85.0 -.1465E-02   86.0 -.1318E-01   87.0 -.2588E-01
+          88.0 -.2246E-01   89.0 -.5371E-02   90.0  .3418E-02   91.0  .2930E-02
+          92.0  .7813E-02   93.0  .1416E-01   94.0  .1025E-01   95.0 -.4883E-03
 122709    96.0 -.1172E-01   97.0 -.1318E-01   98.0 -.1318E-01   99.0 -.1221E-01
+         100.0 -.6836E-02  101.0 -.7324E-02  102.0 -.1953E-02  103.0  .4395E-02
+         104.0  .2002E-01  105.0  .2637E-01  106.0  .1318E-01  107.0  .9766E-03
 122710   108.0 -.7813E-02  109.0 -.1318E-01  110.0 -.1416E-01  111.0 -.1123E-01
+         112.0 -.4883E-03  113.0  .3418E-02  114.0  .2930E-02  115.0  .1025E-01
+         116.0  .2246E-01  117.0  .1807E-01  118.0  .3906E-02  119.0 -.1709E-01
 122711   120.0 -.2734E-01  121.0 -.1563E-01  122.0 -.2930E-02  123.0  .3418E-02
+         124.0  .1465E-02  125.0  .4883E-02  126.0  .1660E-01  127.0  .1465E-01
+         128.0 -.9766E-03  129.0 -.1416E-01  130.0 -.1709E-01  131.0 -.1660E-01
 122712   132.0 -.1123E-01  133.0 -.9277E-02  134.0 -.1221E-01  135.0 -.2051E-01
+         136.0 -.1221E-01  137.0  .7813E-02  138.0  .1514E-01  139.0  .7324E-02
+         140.0  .1953E-02  141.0  .0000E+00  142.0  .8789E-02  143.0  .5371E-02
 122713   144.0 -.9277E-02  145.0 -.2051E-01  146.0 -.2881E-01  147.0 -.3076E-01
+         148.0 -.2148E-01  149.0 -.6348E-02  150.0  .6836E-02  151.0  .1172E-01
+         152.0  .7813E-02  153.0 -.1465E-02  154.0 -.4883E-03  155.0  .1465E-02
 122714   156.0 -.1465E-02  157.0 -.5859E-02  158.0 -.2148E-01  159.0 -.2588E-01
+         160.0 -.1221E-01  161.0  .6348E-02  162.0  .1416E-01  163.0  .1123E-01
+         164.0  .5859E-02  165.0 -.4395E-02  166.0 -.7813E-02  167.0 -.4883E-02
 122715   168.0 -.1465E-02  169.0 -.3906E-02  170.0 -.8789E-02  171.0 -.5371E-02
+         172.0  .4883E-02  173.0  .1416E-01  174.0  .1807E-01  175.0  .1025E-01
+         176.0  .9766E-03  177.0 -.3418E-02  178.0 -.3418E-02  179.0  .1953E-02
 122716   180.0  .7813E-02  181.0  .5371E-02  182.0 -.1465E-02  183.0 -.4395E-02
+         184.0 -.4883E-03  185.0  .3418E-02  186.0 -.4395E-02  187.0 -.1123E-01
+         188.0 -.6836E-02  189.0  .3418E-02  190.0  .2930E-02  191.0  .5859E-02
 122717   192.0  .7813E-02  193.0  .5371E-02  194.0 -.5859E-02  195.0 -.1416E-01
+         196.0 -.1855E-01  197.0 -.1904E-01  198.0 -.1367E-01  199.0  .1953E-02
+         200.0  .1563E-01  201.0  .1660E-01  202.0  .5859E-02  203.0 -.1221E-01
 122718   204.0 -.2588E-01  205.0 -.2832E-01  206.0 -.1904E-01  207.0  .4883E-03
+         208.0  .1270E-01  209.0  .1025E-01  210.0 -.4883E-02  211.0 -.7324E-02
+         212.0 -.4883E-03  213.0  .1465E-02  214.0 -.8789E-02  215.0 -.1270E-01
 122719   216.0  .0000E+00  217.0  .1221E-01  218.0  .1904E-01  219.0  .7813E-02
+         220.0 -.9766E-02  221.0 -.1611E-01  222.0 -.1172E-01  223.0 -.4883E-02
+         224.0 -.4883E-03  225.0  .3418E-02  226.0  .6348E-02  227.0  .9277E-02
 122720   228.0  .1221E-01  229.0  .1953E-01  230.0  .1270E-01  231.0 -.9277E-02
+         232.0 -.1904E-01  233.0 -.1563E-01  234.0 -.2930E-02  235.0  .5859E-02
+         236.0  .3906E-02  237.0 -.5371E-02  238.0 -.1953E-02  239.0  .6836E-02
 122721   240.0  .6836E-02  241.0 -.2930E-02  242.0 -.5371E-02  243.0  .1953E-02
+         244.0  .4395E-02  245.0 -.4883E-03  246.0 -.6348E-02  247.0  .9766E-03
+         248.0  .3418E-02  249.0  .1465E-02  250.0 -.2441E-02  251.0 -.4883E-02
 122722   252.0 -.2441E-02  253.0  .3906E-02  254.0  .1074E-01  255.0  .7813E-02
+         256.0  .2930E-02  257.0 -.4883E-02  258.0 -.1221E-01  259.0 -.1123E-01
+         260.0 -.3906E-02  261.0  .6836E-02  262.0  .7813E-02  263.0  .4883E-02
 122723   264.0 -.4883E-03  265.0 -.5859E-02  266.0 -.2441E-02  267.0 -.7813E-02
+         268.0 -.1123E-01  269.0 -.2441E-02  270.0  .6836E-02  271.0  .1123E-01
+         272.0  .6836E-02  273.0  .4883E-03  274.0 -.3418E-02  275.0 -.2930E-02
 122724   276.0 -.1465E-02  277.0  .1465E-02  278.0  .0000E+00  279.0  .4883E-03
+         280.0  .4883E-03  281.0  .5371E-02  282.0  .3418E-02  283.0  .1953E-02
+         284.0  .9277E-02  285.0  .2441E-02  286.0 -.8789E-02  287.0 -.5859E-02
 122725   288.0  .5371E-02  289.0  .1465E-02  290.0 -.8789E-02  291.0 -.7324E-02
+         292.0  .2930E-02  293.0  .4883E-02  294.0  .2930E-02  295.0 -.3906E-02
+         296.0 -.1025E-01  297.0 -.5859E-02  298.0  .0000E+00  299.0  .1465E-02
 122726   300.0 -.9766E-03  301.0 -.6348E-02  302.0 -.4395E-02  303.0  .3906E-02
+         304.0  .8301E-02  305.0  .1123E-01  306.0  .1758E-01  307.0  .1318E-01
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+	308.0	-.4395E-02	309.0	-.1953E-01	310.0	-.2148E-01	311.0	-.1074E-01
122727	312.0	.3418E-02	313.0	.3418E-02	314.0	-.5371E-02	315.0	-.7813E-02
+	316.0	.0000E+00	317.0	.1074E-01	318.0	.1514E-01	319.0	.1025E-01
+	320.0	-.7813E-02	321.0	-.1416E-01	322.0	-.6348E-02	323.0	.6348E-02
122728	324.0	.2441E-02	325.0	-.9766E-02	326.0	-.1367E-01	327.0	-.4395E-02
+	328.0	.1465E-01	329.0	.2295E-01	330.0	.1563E-01	331.0	.2441E-02
+	332.0	-.4395E-02	333.0	-.7324E-02	334.0	-.1025E-01	335.0	-.4395E-02
122729	336.0	.1953E-02	337.0	.2441E-02	338.0	.4883E-03	339.0	-.1953E-02
+	340.0	.9277E-02	341.0	.1514E-01	342.0	.1172E-01	343.0	.3906E-02
+	344.0	-.6836E-02	345.0	-.1172E-01	346.0	-.1660E-01	347.0	-.2246E-01
122730	348.0	-.2148E-01	349.0	-.3906E-02	350.0	.1758E-01	351.0	.3027E-01
+	352.0	.2490E-01	353.0	.8789E-02	354.0	-.8301E-02	355.0	-.1514E-01
+	356.0	-.1318E-01	357.0	-.1172E-01	358.0	-.8301E-02	359.0	-.2441E-02
122731	360.0	.9766E-03	361.0	.6836E-02	362.0	.1025E-01	363.0	.3418E-02
+	364.0	-.5371E-02	365.0	-.3418E-02	366.0	.1953E-02	367.0	.4395E-02
+	368.0	.0000E+00	369.0	-.5859E-02	370.0	-.1953E-02	371.0	.1465E-02
122732	372.0	-.4883E-03	373.0	-.4395E-02	374.0	-.2441E-02	375.0	.2930E-02
+	376.0	.3906E-02	377.0	.3418E-02	378.0	.1953E-02	379.0	-.9766E-03
+	380.0	-.4883E-02	381.0	-.8789E-02	382.0	-.1660E-01	383.0	-.9277E-02
122733	384.0	.6836E-02	385.0	.1416E-01	386.0	.1123E-01	387.0	.2441E-02
+	388.0	-.5859E-02	389.0	-.7813E-02	390.0	-.4395E-02	391.0	.0000E+00
+	392.0	.3418E-02	393.0	.0000E+00	394.0	.0000E+00	395.0	.1953E-02
122734	396.0	.6836E-02	397.0	.6836E-02	398.0	.5371E-02	399.0	.5371E-02
+	400.0	.0000E+00	401.0	-.9766E-02	402.0	-.2002E-01	403.0	-.2295E-01
+	404.0	-.4883E-02	405.0	.1611E-01	406.0	.1807E-01	407.0	.1416E-01
122735	408.0	-.1953E-02	409.0	-.1563E-01	410.0	-.1904E-01	411.0	-.1221E-01
+	412.0	-.4883E-03	413.0	.1025E-01	414.0	.1074E-01	415.0	.1025E-01
+	416.0	.6836E-02	417.0	.4395E-02	418.0	-.4395E-02	419.0	-.1465E-01
122736	420.0	-.1318E-01	421.0	-.7813E-02	422.0	-.4883E-02	423.0	.4883E-02
+	424.0	.1953E-02	425.0	-.5371E-02	426.0	-.9766E-02	427.0	-.2441E-02
+	428.0	.1465E-01	429.0	.1611E-01	430.0	.1221E-01	431.0	-.1953E-02
122737	432.0	-.1172E-01	433.0	-.1855E-01	434.0	-.1563E-01	435.0	-.2930E-02
+	436.0	.1758E-01	437.0	.2734E-01	438.0	.1318E-01	439.0	-.6836E-02
+	440.0	-.1855E-01	441.0	-.1855E-01	442.0	-.1221E-01	443.0	-.3418E-02
122738	444.0	.1465E-02	445.0	.6348E-02	446.0	.9766E-02	447.0	.9277E-02
+	448.0	.4395E-02	449.0	-.4395E-02	450.0	-.7324E-02	451.0	-.9766E-02
+	452.0	-.5371E-02	453.0	-.3906E-02	454.0	-.9766E-03	455.0	.2930E-02
122739	456.0	.2930E-02	457.0	.4883E-02	458.0	.2930E-02	459.0	-.5859E-02
+	460.0	-.7324E-02	461.0	-.5859E-02	462.0	-.7813E-02	463.0	-.8789E-02
+	464.0	-.5859E-02	465.0	.4883E-03	466.0	.9277E-02	467.0	.1953E-01
122740	468.0	.1416E-01	469.0	.2930E-02	470.0	-.2441E-02	471.0	-.2930E-02
+	472.0	-.1953E-02	473.0	-.3418E-02	474.0	-.6836E-02	475.0	.3906E-02
+	476.0	-.4883E-03	477.0	-.6348E-02	478.0	-.9766E-03	479.0	.9766E-02
122741	480.0	.1367E-01	481.0	.1465E-01	482.0	.1465E-01	483.0	.7324E-02
+	484.0	.9766E-03	485.0	-.5859E-02	486.0	-.1025E-01	487.0	-.1123E-01
+	488.0	-.1221E-01	489.0	-.1221E-01	490.0	-.2441E-02	491.0	.1318E-01
122742	492.0	.2295E-01	493.0	.1563E-01	494.0	.7813E-02	495.0	-.4883E-02
+	496.0	-.1025E-01	497.0	-.1465E-02	498.0	.6836E-02	499.0	.3906E-02
+	500.0	-.7324E-02	501.0	-.1025E-01	502.0	-.3906E-02	503.0	.1953E-02
122743	504.0	.2930E-02	505.0	.2930E-02	506.0	.4395E-02	507.0	-.3418E-02
+	508.0	-.8301E-02	509.0	-.8301E-02	510.0	-.4883E-03	511.0	.1123E-01
+	512.0	.1367E-01	513.0	.9766E-02	514.0	-.5371E-02	515.0	-.1416E-01
122744	516.0	-.1123E-01	517.0	-.9766E-03	518.0	.7324E-02	519.0	.8789E-02
+	520.0	.9766E-03	521.0	-.9766E-02	522.0	-.1465E-01	523.0	-.1270E-01
+	524.0	-.9277E-02	525.0	-.4395E-02	526.0	-.4883E-03	527.0	.2930E-02
122745	528.0	.1709E-01	529.0	.2441E-01	530.0	.1514E-01	531.0	.2930E-02
+	532.0	-.6348E-02	533.0	-.1953E-01	534.0	-.2295E-01	535.0	-.1074E-01
+	536.0	.1465E-02	537.0	.9766E-03	538.0	-.5371E-02	539.0	.3418E-02
122746	540.0	.2246E-01	541.0	.2197E-01	542.0	.4883E-02	543.0	-.1367E-01
+	544.0	-.1514E-01	545.0	-.3906E-02	546.0	.5859E-02	547.0	.9766E-03
+	548.0	-.6348E-02	549.0	.1465E-02	550.0	.1172E-01	551.0	.1221E-01
122747	552.0	-.2930E-02	553.0	-.1514E-01	554.0	-.1074E-01	555.0	.6348E-02
+	556.0	.1563E-01	557.0	.1074E-01	558.0	-.4883E-03	559.0	-.7813E-02
+	560.0	-.5371E-02	561.0	-.3906E-02	562.0	.2930E-02	563.0	.4395E-02
122748	564.0	.9766E-03	565.0	.1953E-02	566.0	.4395E-02	567.0	-.9766E-03
+	568.0	-.5371E-02	569.0	-.1465E-02	570.0	.4883E-02	571.0	-.9766E-03
+	572.0	-.8789E-02	573.0	-.1270E-01	574.0	-.6836E-02	575.0	.1953E-02
122749	576.0	.5371E-02	577.0	.4883E-02	578.0	-.5371E-02	579.0	-.5859E-02
+	580.0	.8301E-02	581.0	.1660E-01	582.0	.1318E-01	583.0	-.3418E-02
+	584.0	-.2100E-01	585.0	-.2295E-01	586.0	-.1025E-01	587.0	-.9766E-03
122750	588.0	.2441E-02	589.0	-.9766E-03	590.0	-.9766E-03	591.0	.3418E-02
+	592.0	-.4883E-03	593.0	-.5859E-02	594.0	-.2930E-02	595.0	.4883E-02
+	596.0	.9766E-02	597.0	.5859E-02	598.0	-.1172E-01	599.0	-.3223E-01
122751	600.0	-.3223E-01	601.0	-.1172E-01	602.0	.8789E-02	603.0	.9277E-02
+	604.0	-.1465E-02	605.0	-.6836E-02	606.0	-.2930E-02	607.0	.1465E-02
+	608.0	-.3906E-02	609.0	-.1025E-01	610.0	-.1367E-01	611.0	-.8301E-02
122752	612.0	.4395E-02	613.0	.9766E-02	614.0	.4395E-02	615.0	-.1465E-02
+	616.0	-.4883E-02	617.0	-.1172E-01	618.0	-.9766E-02	619.0	-.4883E-02
+	620.0	.8789E-02	621.0	.1904E-01	622.0	.1709E-01	623.0	.4883E-03
122753	624.0	-.1123E-01	625.0	-.1172E-01	626.0	-.2441E-02	627.0	.1465E-02

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+        628.0  .1465E-02  629.0  .8301E-02  630.0  .1270E-01  631.0  .1514E-01
+        632.0  .1123E-01  633.0 -.4883E-02  634.0 -.1611E-01  635.0 -.1514E-01
 122754  636.0 -.7813E-02  637.0  .5859E-02  638.0  .1660E-01  639.0  .1465E-01
+        640.0  .1465E-02  641.0 -.4883E-02  642.0 -.1270E-01  643.0 -.1563E-01
+        644.0 -.1025E-01  645.0  .1465E-02  646.0  .1611E-01  647.0  .1855E-01
 122755  648.0  .6836E-02  649.0 -.7324E-02  650.0 -.1318E-01  651.0  .1953E-02
+        652.0  .1270E-01  653.0  .1025E-01  654.0 -.4883E-02  655.0 -.1904E-01
+        656.0 -.1318E-01  657.0 -.4395E-02  658.0 -.9766E-03  659.0  .8301E-02
 122756  660.0  .1758E-01  661.0  .1660E-01  662.0  .6348E-02  663.0 -.1172E-01
+        664.0 -.2100E-01  665.0 -.2002E-01  666.0 -.8301E-02  667.0  .8789E-02
+        668.0  .2197E-01  669.0  .2393E-01  670.0  .1465E-01  671.0 -.1953E-02
 122757  672.0 -.1709E-01  673.0 -.1807E-01  674.0 -.1416E-01  675.0 -.1953E-02
+        676.0  .8301E-02  677.0  .3418E-02  678.0 -.5371E-02  679.0 -.1025E-01
+        680.0 -.3418E-02  681.0  .1123E-01  682.0  .2100E-01  683.0  .1514E-01
 122758  684.0 -.2930E-02  685.0 -.1611E-01  686.0 -.6836E-02  687.0  .7324E-02
+        688.0  .1465E-02  689.0 -.1025E-01  690.0 -.1563E-01  691.0 -.3418E-02
+        692.0  .1367E-01  693.0  .1318E-01  694.0  .8789E-02  695.0  .1953E-02
 122759  696.0 -.9766E-02  697.0 -.1221E-01  698.0 -.1270E-01  699.0 -.1025E-01
+        700.0 -.4395E-02  701.0  .5371E-02  702.0  .1953E-01  703.0  .1855E-01
+        704.0  .4883E-02  705.0 -.7324E-02  706.0 -.3418E-02  707.0  .6836E-02
 122760  708.0  .9766E-03  709.0 -.1074E-01  710.0 -.1660E-01  711.0 -.1025E-01
+        712.0  .2930E-02  713.0  .1270E-01  714.0  .1514E-01  715.0  .4395E-02
+        716.0 -.4395E-02  717.0 -.9766E-03  718.0  .5371E-02  719.0  .1025E-01
 122761  720.0  .5371E-02  721.0 -.6348E-02  722.0 -.1465E-01  723.0 -.2295E-01
+        724.0 -.1807E-01  725.0 -.1953E-02  726.0  .8789E-02  727.0  .1270E-01
+        728.0  .1465E-01  729.0  .1465E-02  730.0 -.2930E-02  731.0 -.6348E-02
 122762  732.0 -.3418E-02  733.0  .0000E+00  734.0  .9766E-03  735.0 -.4395E-02
+        736.0 -.5859E-02  737.0 -.2441E-02  738.0 -.1465E-02  739.0  .2441E-02
+        740.0  .4883E-03  741.0 -.4883E-03  742.0  .3418E-02  743.0  .1172E-01
 122763  744.0  .2441E-02  745.0 -.1660E-01  746.0 -.2295E-01  747.0 -.7813E-02
+        748.0  .2930E-02  749.0  .4883E-02  750.0  .7324E-02  751.0  .8789E-02
+        752.0 -.4883E-03  753.0 -.1465E-01  754.0 -.1709E-01  755.0 -.1416E-01
 122764  756.0 -.1514E-01  757.0 -.1611E-01  758.0 -.9766E-02  759.0  .1953E-02
+        760.0  .1367E-01  761.0  .1904E-01  762.0  .1465E-01  763.0  .3418E-02
+        764.0 -.9766E-02  765.0 -.1709E-01  766.0 -.1807E-01  767.0 -.8789E-02
 122765  768.0  .2441E-02  769.0  .4395E-02  770.0 -.4883E-03  771.0 -.2930E-02
+        772.0 -.1465E-02  773.0  .2441E-02  774.0  .7813E-02  775.0  .5859E-02
+        776.0 -.1465E-02  777.0 -.8789E-02  778.0 -.1318E-01  779.0 -.4395E-02
 122766  780.0  .8789E-02
 122800 781      * NO.2 S.G. Z-ACCELERATION (G)
 122801     .0  .4433E-01    1.0  .4494E-01    2.0  .4190E-01    3.0  .3158E-01
 122801     .0  .0           1.0  .4494E-01    2.0  .4190E-01    3.0  .3158E-01
+          4.0  .2611E-01    5.0  .2429E-01    6.0  .2186E-01    7.0  .2247E-01
+          8.0  .2794E-01    9.0  .3583E-01   10.0  .4494E-01   11.0  .4616E-01
 122802   12.0  .3522E-01   13.0  .3097E-01   14.0  .2854E-01   15.0  .3280E-01
+         16.0  .3401E-01   17.0  .3158E-01   18.0  .3280E-01   19.0  .4008E-01
+         20.0  .3948E-01   21.0  .3522E-01   22.0  .2854E-01   23.0  .2004E-01
 122803   24.0  .3158E-01   25.0  .4251E-01   26.0  .4676E-01   27.0  .4312E-01
+         28.0  .2915E-01   29.0  .2308E-01   30.0  .2490E-01   31.0  .3948E-01
+         32.0  .4373E-01   33.0  .3280E-01   34.0  .1640E-01   35.0  .1032E-01
 122804   36.0  .2126E-01   37.0  .4312E-01   38.0  .5466E-01   39.0  .5101E-01
+         40.0  .4616E-01   41.0  .3765E-01   42.0  .2794E-01   43.0  .1761E-01
+         44.0  .1518E-01   45.0  .3097E-01   46.0  .4919E-01   47.0  .5284E-01
 122805   48.0  .3280E-01   49.0  .1579E-01   50.0  .1154E-01   51.0  .3158E-01
+         52.0  .4859E-01   53.0  .4859E-01   54.0  .3948E-01   55.0  .3887E-01
+         56.0  .3097E-01   57.0  .1943E-01   58.0  .1640E-01   59.0  .2976E-01
 122806   60.0  .3644E-01   61.0  .3644E-01   62.0  .3158E-01   63.0  .3097E-01
+         64.0  .3705E-01   65.0  .4494E-01   66.0  .4008E-01   67.0  .2915E-01
+         68.0  .2915E-01   69.0  .3644E-01   70.0  .4008E-01   71.0  .3037E-01
 122807   72.0  .1943E-01   73.0  .1822E-01   74.0  .3158E-01   75.0  .4555E-01
+         76.0  .4798E-01   77.0  .3644E-01   78.0  .2126E-01   79.0  .1700E-01
+         80.0  .3887E-01   81.0  .5769E-01   82.0  .5769E-01   83.0  .3644E-01
 122808   84.0  .1275E-01   85.0  .8502E-02   86.0  .1943E-01   87.0  .3462E-01
+         88.0  .3887E-01   89.0  .3280E-01   90.0  .2915E-01   91.0  .3644E-01
+         92.0  .4798E-01   93.0  .5405E-01   94.0  .4373E-01   95.0  .2854E-01
 122809   96.0  .2611E-01   97.0  .2611E-01   98.0  .2429E-01   99.0  .1397E-01
+        100.0  .1458E-01  101.0  .2794E-01  102.0  .5891E-01  103.0  .6802E-01
+        104.0  .4433E-01  105.0  .1883E-01  106.0  .1032E-01  107.0  .2915E-01
 122810  108.0  .3705E-01  109.0  .3705E-01  110.0  .3037E-01  111.0  .3097E-01
+        112.0  .4069E-01  113.0  .4008E-01  114.0  .3401E-01  115.0  .3583E-01
+        116.0  .3765E-01  117.0  .3705E-01  118.0  .2490E-01  119.0  .1275E-01
 122811  120.0  .1458E-01  121.0  .3583E-01  122.0  .4616E-01  123.0  .4859E-01
+        124.0  .3583E-01  125.0  .2854E-01  126.0  .3522E-01  127.0  .4251E-01
+        128.0  .3705E-01  129.0  .3158E-01  130.0  .2794E-01  131.0  .2915E-01
 122812  132.0  .3097E-01  133.0  .2490E-01  134.0  .1883E-01  135.0  .2854E-01
+        136.0  .4676E-01  137.0  .5891E-01  138.0  .5041E-01  139.0  .2429E-01
+        140.0  .1822E-01  141.0  .2672E-01  142.0  .3705E-01  143.0  .3097E-01
 122813  144.0  .2065E-01  145.0  .2186E-01  146.0  .4130E-01  147.0  .5527E-01
+        148.0  .4251E-01  149.0  .2186E-01  150.0  .1458E-01  151.0  .2733E-01
+        152.0  .4737E-01  153.0  .5284E-01  154.0  .3522E-01  155.0  .8502E-02
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122814	156.0	-.1822E-02	157.0	.2126E-01	158.0	.5405E-01	159.0	.7166E-01
+	160.0	.6316E-01	161.0	.2976E-01	162.0	.2429E-02	163.0	.6073E-03
+	164.0	.1640E-01	165.0	.4312E-01	166.0	.5891E-01	167.0	.5830E-01
122815	168.0	.4251E-01	169.0	.2611E-01	170.0	.1883E-01	171.0	.2004E-01
+	172.0	.2672E-01	173.0	.3158E-01	174.0	.3826E-01	175.0	.3340E-01
+	176.0	.3705E-01	177.0	.3765E-01	178.0	.3887E-01	179.0	.4190E-01
122816	180.0	.4069E-01	181.0	.3765E-01	182.0	.3037E-01	183.0	.2065E-01
+	184.0	.1093E-01	185.0	.1761E-01	186.0	.3462E-01	187.0	.5344E-01
+	188.0	.5101E-01	189.0	.4373E-01	190.0	.3340E-01	191.0	.3462E-01
122817	192.0	.2733E-01	193.0	.2854E-01	194.0	.2672E-01	195.0	.3462E-01
+	196.0	.4008E-01	197.0	.3401E-01	198.0	.2490E-01	199.0	.2126E-01
+	200.0	.2733E-01	201.0	.3522E-01	202.0	.4433E-01	203.0	.4616E-01
122818	204.0	.4190E-01	205.0	.4069E-01	206.0	.3219E-01	207.0	.1700E-01
+	208.0	.1275E-01	209.0	.2915E-01	210.0	.4859E-01	211.0	.4859E-01
+	212.0	.3219E-01	213.0	.1943E-01	214.0	.2247E-01	215.0	.3583E-01
122819	216.0	.4980E-01	217.0	.4555E-01	218.0	.3219E-01	219.0	.2126E-01
+	220.0	.2733E-01	221.0	.3644E-01	222.0	.4251E-01	223.0	.3644E-01
+	224.0	.2854E-01	225.0	.2794E-01	226.0	.3765E-01	227.0	.4616E-01
122820	228.0	.4008E-01	229.0	.3219E-01	230.0	.2004E-01	231.0	.9717E-02
+	232.0	.1700E-01	233.0	.3644E-01	234.0	.5284E-01	235.0	.5344E-01
+	236.0	.3887E-01	237.0	.2672E-01	238.0	.2369E-01	239.0	.3219E-01
122821	240.0	.4312E-01	241.0	.4190E-01	242.0	.2429E-01	243.0	.1640E-01
+	244.0	.2429E-01	245.0	.4980E-01	246.0	.5284E-01	247.0	.3583E-01
+	248.0	.9110E-02	249.0	.1275E-01	250.0	.3583E-01	251.0	.5527E-01
122822	252.0	.6498E-01	253.0	.3948E-01	254.0	.1397E-01	255.0	-.3644E-02
+	256.0	.1640E-01	257.0	.5344E-01	258.0	.7470E-01	259.0	.5891E-01
+	260.0	.1822E-01	261.0	.0000E+00	262.0	.1458E-01	263.0	.3401E-01
122823	264.0	.4555E-01	265.0	.3765E-01	266.0	.3644E-01	267.0	.4312E-01
+	268.0	.4798E-01	269.0	.4433E-01	270.0	.2611E-01	271.0	.1458E-01
+	272.0	.1397E-01	273.0	.3158E-01	274.0	.4433E-01	275.0	.4798E-01
122824	276.0	.3522E-01	277.0	.2915E-01	278.0	.3037E-01	279.0	.3765E-01
+	280.0	.3887E-01	281.0	.3583E-01	282.0	.2976E-01	283.0	.2247E-01
+	284.0	.2794E-01	285.0	.3522E-01	286.0	.3522E-01	287.0	.2672E-01
122825	288.0	.3583E-01	289.0	.5284E-01	290.0	.5769E-01	291.0	.3522E-01
+	292.0	.1275E-01	293.0	.1336E-01	294.0	.3522E-01	295.0	.4798E-01
+	296.0	.4069E-01	297.0	.2672E-01	298.0	.2308E-01	299.0	.2733E-01
122826	300.0	.2611E-01	301.0	.2611E-01	302.0	.3705E-01	303.0	.5162E-01
+	304.0	.5709E-01	305.0	.4616E-01	306.0	.3037E-01	307.0	.2065E-01
+	308.0	.2065E-01	309.0	.2490E-01	310.0	.2429E-01	311.0	.2247E-01
122827	312.0	.2915E-01	313.0	.5162E-01	314.0	.6498E-01	315.0	.5284E-01
+	316.0	.2369E-01	317.0	.4859E-02	318.0	.1518E-01	319.0	.3097E-01
+	320.0	.3705E-01	321.0	.2976E-01	322.0	.2794E-01	323.0	.3522E-01
122828	324.0	.4980E-01	325.0	.5344E-01	326.0	.3826E-01	327.0	.1336E-01
+	328.0	.1215E-01	329.0	.3522E-01	330.0	.5466E-01	331.0	.5466E-01
+	332.0	.3037E-01	333.0	.1215E-01	334.0	.9110E-02	335.0	.2976E-01
122829	336.0	.4008E-01	337.0	.3583E-01	338.0	.2915E-01	339.0	.3401E-01
+	340.0	.4798E-01	341.0	.5223E-01	342.0	.4190E-01	343.0	.3037E-01
+	344.0	.1518E-01	345.0	.2004E-01	346.0	.2672E-01	347.0	.3219E-01
122830	348.0	.4373E-01	349.0	.4859E-01	350.0	.4190E-01	351.0	.2551E-01
+	352.0	.2004E-01	353.0	.2854E-01	354.0	.4130E-01	355.0	.4373E-01
+	356.0	.3765E-01	357.0	.2186E-01	358.0	.1640E-01	359.0	.2369E-01
122831	360.0	.4069E-01	361.0	.5587E-01	362.0	.4555E-01	363.0	.2429E-01
+	364.0	.2186E-01	365.0	.4069E-01	366.0	.5223E-01	367.0	.4737E-01
+	368.0	.2369E-01	369.0	.1822E-02	370.0	.8502E-02	371.0	.3522E-01
122832	372.0	.6073E-01	373.0	.6984E-01	374.0	.5101E-01	375.0	.1822E-01
+	376.0	.6073E-03	377.0	.7288E-02	378.0	.3462E-01	379.0	.5769E-01
+	380.0	.6073E-01	381.0	.4616E-01	382.0	.1640E-01	383.0	-.6073E-03
122833	384.0	.7895E-02	385.0	.3705E-01	386.0	.5830E-01	387.0	.5830E-01
+	388.0	.4069E-01	389.0	.2490E-01	390.0	.2247E-01	391.0	.3705E-01
+	392.0	.4737E-01	393.0	.4494E-01	394.0	.3522E-01	395.0	.2186E-01
122834	396.0	.2004E-01	397.0	.2126E-01	398.0	.2429E-01	399.0	.2733E-01
+	400.0	.3097E-01	401.0	.4251E-01	402.0	.5587E-01	403.0	.5041E-01
+	404.0	.3280E-01	405.0	.1518E-01	406.0	.2065E-01	407.0	.4555E-01
122835	408.0	.5466E-01	409.0	.4312E-01	410.0	.2369E-01	411.0	.1761E-01
+	412.0	.2065E-01	413.0	.3462E-01	414.0	.3765E-01	415.0	.3401E-01
+	416.0	.2369E-01	417.0	.2915E-01	418.0	.4737E-01	419.0	.4980E-01
122836	420.0	.4008E-01	421.0	.2186E-01	422.0	.1579E-01	423.0	.3158E-01
+	424.0	.4555E-01	425.0	.4919E-01	426.0	.4008E-01	427.0	.2733E-01
+	428.0	.2308E-01	429.0	.1579E-01	430.0	.2308E-01	431.0	.3765E-01
122837	432.0	.6377E-01	433.0	.6316E-01	434.0	.4069E-01	435.0	.8502E-02
+	436.0	-.3644E-02	437.0	.1458E-01	438.0	.4433E-01	439.0	.6012E-01
+	440.0	.5284E-01	441.0	.3765E-01	442.0	.2429E-01	443.0	.1093E-01
122838	444.0	.6680E-02	445.0	.3158E-01	446.0	.6012E-01	447.0	.7470E-01
+	448.0	.6680E-01	449.0	.3097E-01	450.0	-.1822E-02	451.0	-.1154E-01
+	452.0	.5466E-02	453.0	.3826E-01	454.0	.6680E-01	455.0	.6680E-01
122839	456.0	.4190E-01	457.0	.2308E-01	458.0	.2065E-01	459.0	.2854E-01
+	460.0	.3826E-01	461.0	.3644E-01	462.0	.2733E-01	463.0	.2308E-01
+	464.0	.3462E-01	465.0	.4494E-01	466.0	.4130E-01	467.0	.3158E-01
122840	468.0	.2794E-01	469.0	.4190E-01	470.0	.4737E-01	471.0	.3705E-01
+	472.0	.2369E-01	473.0	.1336E-01	474.0	.1275E-01	475.0	.2794E-01

+	476.0	.4494E-01	477.0	.5405E-01	478.0	.5101E-01	479.0	.3887E-01
122841	480.0	.2794E-01	481.0	.2247E-01	482.0	.2976E-01	483.0	.3826E-01
+	484.0	.4008E-01	485.0	.3401E-01	486.0	.2247E-01	487.0	.1397E-01
+	488.0	.3037E-01	489.0	.4676E-01	490.0	.5041E-01	491.0	.3583E-01
122842	492.0	.2490E-01	493.0	.2490E-01	494.0	.3280E-01	495.0	.3401E-01
+	496.0	.3765E-01	497.0	.4008E-01	498.0	.3826E-01	499.0	.3887E-01
+	500.0	.2854E-01	501.0	.3037E-01	502.0	.3280E-01	503.0	.2915E-01
122843	504.0	.2854E-01	505.0	.3158E-01	506.0	.4190E-01	507.0	.3948E-01
+	508.0	.2976E-01	509.0	.2308E-01	510.0	.3158E-01	511.0	.5101E-01
+	512.0	.4251E-01	513.0	.2733E-01	514.0	.1458E-01	515.0	.1883E-01
122844	516.0	.4190E-01	517.0	.6134E-01	518.0	.5527E-01	519.0	.2915E-01
+	520.0	.6073E-03	521.0	-.4251E-02	522.0	.2794E-01	523.0	.6620E-01
+	524.0	.7409E-01	525.0	.5101E-01	526.0	.1822E-01	527.0	.4859E-02
122845	528.0	.2429E-01	529.0	.4008E-01	530.0	.4616E-01	531.0	.4008E-01
+	532.0	.2915E-01	533.0	.1883E-01	534.0	.2065E-01	535.0	.3340E-01
+	536.0	.4676E-01	537.0	.4798E-01	538.0	.3219E-01	539.0	.2733E-01
122846	540.0	.4251E-01	541.0	.5466E-01	542.0	.4433E-01	543.0	.1822E-01
+	544.0	.6073E-03	545.0	.9110E-02	546.0	.3280E-01	547.0	.5466E-01
+	548.0	.6316E-01	549.0	.5648E-01	550.0	.2915E-01	551.0	.1154E-01
122847	552.0	.7288E-02	553.0	.2611E-01	554.0	.4190E-01	555.0	.4798E-01
+	556.0	.3948E-01	557.0	.3705E-01	558.0	.3765E-01	559.0	.2915E-01
+	560.0	.2004E-01	561.0	.2308E-01	562.0	.3280E-01	563.0	.4859E-01
122848	564.0	.5162E-01	565.0	.4616E-01	566.0	.3340E-01	567.0	.1700E-01
+	568.0	.2065E-01	569.0	.2976E-01	570.0	.3340E-01	571.0	.2733E-01
+	572.0	.2308E-01	573.0	.3158E-01	574.0	.4373E-01	575.0	.4980E-01
122849	576.0	.4616E-01	577.0	.4251E-01	578.0	.3705E-01	579.0	.2551E-01
+	580.0	.2308E-01	581.0	.1761E-01	582.0	.2611E-01	583.0	.3765E-01
+	584.0	.4494E-01	585.0	.4069E-01	586.0	.2490E-01	587.0	.1458E-01
122850	588.0	.3462E-01	589.0	.5284E-01	590.0	.4737E-01	591.0	.3644E-01
+	592.0	.2854E-01	593.0	.2976E-01	594.0	.3340E-01	595.0	.2551E-01
+	596.0	.2551E-01	597.0	.3219E-01	598.0	.4130E-01	599.0	.4373E-01
122851	600.0	.3462E-01	601.0	.2611E-01	602.0	.2915E-01	603.0	.3705E-01
+	604.0	.3705E-01	605.0	.3097E-01	606.0	.2247E-01	607.0	.2551E-01
+	608.0	.3826E-01	609.0	.5405E-01	610.0	.5527E-01	611.0	.4069E-01
122852	612.0	.2186E-01	613.0	.1032E-01	614.0	.1458E-01	615.0	.3340E-01
+	616.0	.4859E-01	617.0	.4798E-01	618.0	.3219E-01	619.0	.1336E-01
+	620.0	.1822E-01	621.0	.4190E-01	622.0	.5830E-01	623.0	.5648E-01
122853	624.0	.3826E-01	625.0	.1518E-01	626.0	.8502E-02	627.0	.1579E-01
+	628.0	.3462E-01	629.0	.5587E-01	630.0	.6134E-01	631.0	.4737E-01
+	632.0	.3097E-01	633.0	.1032E-01	634.0	.9110E-02	635.0	.2369E-01
122854	636.0	.4616E-01	637.0	.5587E-01	638.0	.4433E-01	639.0	.2186E-01
+	640.0	.1579E-01	641.0	.3097E-01	642.0	.4798E-01	643.0	.4555E-01
+	644.0	.3280E-01	645.0	.2369E-01	646.0	.2794E-01	647.0	.4312E-01
122855	648.0	.4069E-01	649.0	.3340E-01	650.0	.1822E-01	651.0	.2126E-01
+	652.0	.3401E-01	653.0	.4737E-01	654.0	.5648E-01	655.0	.4798E-01
+	656.0	.3826E-01	657.0	.1579E-01	658.0	.6073E-02	659.0	.1275E-01
122856	660.0	.2854E-01	661.0	.4555E-01	662.0	.4980E-01	663.0	.4130E-01
+	664.0	.3644E-01	665.0	.3887E-01	666.0	.4494E-01	667.0	.4555E-01
+	668.0	.2429E-01	669.0	.1215E-01	670.0	.1579E-01	671.0	.3583E-01
122857	672.0	.4555E-01	673.0	.3522E-01	674.0	.1883E-01	675.0	.2247E-01
+	676.0	.4555E-01	677.0	.5891E-01	678.0	.4676E-01	679.0	.2490E-01
+	680.0	.2065E-01	681.0	.3219E-01	682.0	.4676E-01	683.0	.3705E-01
122858	684.0	.1761E-01	685.0	.2004E-01	686.0	.3462E-01	687.0	.4676E-01
+	688.0	.4251E-01	689.0	.3340E-01	690.0	.2611E-01	691.0	.2733E-01
+	692.0	.3401E-01	693.0	.3462E-01	694.0	.3522E-01	695.0	.3644E-01
122859	696.0	.3705E-01	697.0	.3826E-01	698.0	.4130E-01	699.0	.3401E-01
+	700.0	.2429E-01	701.0	.2004E-01	702.0	.2976E-01	703.0	.5041E-01
+	704.0	.5709E-01	705.0	.4190E-01	706.0	.1032E-01	707.0	.6073E-03
122860	708.0	.1458E-01	709.0	.4312E-01	710.0	.6073E-01	711.0	.4859E-01
+	712.0	.3644E-01	713.0	.3097E-01	714.0	.4008E-01	715.0	.3887E-01
+	716.0	.1943E-01	717.0	.1640E-01	718.0	.2794E-01	719.0	.5344E-01
122861	720.0	.5162E-01	721.0	.2672E-01	722.0	.1275E-01	723.0	.1579E-01
+	724.0	.3462E-01	725.0	.4616E-01	726.0	.4555E-01	727.0	.3644E-01
+	728.0	.4008E-01	729.0	.3522E-01	730.0	.3097E-01	731.0	.2854E-01
122862	732.0	.3280E-01	733.0	.4494E-01	734.0	.4312E-01	735.0	.2794E-01
+	736.0	.4251E-02	737.0	.1032E-01	738.0	.3401E-01	739.0	.6316E-01
+	740.0	.6741E-01	741.0	.3826E-01	742.0	.1275E-01	743.0	.9110E-02
122863	744.0	.3097E-01	745.0	.4798E-01	746.0	.4494E-01	747.0	.3219E-01
+	748.0	.2854E-01	749.0	.3097E-01	750.0	.2854E-01	751.0	.3158E-01
+	752.0	.3887E-01	753.0	.3705E-01	754.0	.3462E-01	755.0	.3583E-01
122864	756.0	.3522E-01	757.0	.3280E-01	758.0	.2733E-01	759.0	.2369E-01
+	760.0	.2429E-01	761.0	.3401E-01	762.0	.3765E-01	763.0	.4130E-01
+	764.0	.4676E-01	765.0	.4373E-01	766.0	.2915E-01	767.0	.1275E-01
122865	768.0	.1458E-01	769.0	.3826E-01	770.0	.5891E-01	771.0	.5830E-01
+	772.0	.3340E-01	773.0	.7895E-02	774.0	-.3037E-02	775.0	.1458E-01
+	776.0	.4798E-01	777.0	.7470E-01	778.0	.6863E-01	779.0	.3583E-01
122866	780.0	.0000E+00						
122900	781	* PRZ Z-ACCELERATION (G)						
122901	.0	.2692E-01	1.0	.2815E-01	2.0	.2325E-01	3.0	.1407E-01
122901	.0	.0	1.0	.2815E-01	2.0	.2325E-01	3.0	.1407E-01

+	4.0	.9178E-02	5.0	.5507E-02	6.0	.3671E-02	7.0	.3671E-02
+	8.0	.4283E-02	9.0	.1346E-01	10.0	.2509E-01	11.0	.2876E-01
122902	12.0	.2080E-01	13.0	.1958E-01	14.0	.1530E-01	15.0	.1346E-01
+	16.0	.9178E-02	17.0	.4895E-02	18.0	.1163E-01	19.0	.2325E-01
+	20.0	.2264E-01	21.0	.1530E-01	22.0	.7343E-02	23.0	.6119E-03
122903	24.0	.1224E-01	25.0	.2509E-01	26.0	.3304E-01	27.0	.2937E-01
+	28.0	.1652E-01	29.0	.6731E-02	30.0	.1836E-02	31.0	.1407E-01
+	32.0	.1897E-01	33.0	.9790E-02	34.0	-.5507E-02	35.0	-.7343E-02
122904	36.0	.4895E-02	37.0	.2631E-01	38.0	.3671E-01	39.0	.3610E-01
+	40.0	.3243E-01	41.0	.2203E-01	42.0	.1101E-01	43.0	-.2448E-02
+	44.0	-.9178E-02	45.0	.7343E-02	46.0	.2631E-01	47.0	.3059E-01
122905	48.0	.1530E-01	49.0	.6119E-03	50.0	-.1836E-02	51.0	.1591E-01
+	52.0	.3121E-01	53.0	.3121E-01	54.0	.2570E-01	55.0	.2325E-01
+	56.0	.8566E-02	57.0	-.5507E-02	58.0	-.1040E-01	59.0	.7954E-02
122906	60.0	.1774E-01	61.0	.1958E-01	62.0	.1836E-01	63.0	.1713E-01
+	64.0	.2203E-01	65.0	.2753E-01	66.0	.1958E-01	67.0	.1040E-01
+	68.0	.1163E-01	69.0	.1713E-01	70.0	.1713E-01	71.0	.7343E-02
122907	72.0	-.1224E-02	73.0	.2448E-02	74.0	.1897E-01	75.0	.3059E-01
+	76.0	.2937E-01	77.0	.1530E-01	78.0	.1836E-02	79.0	.3671E-02
+	80.0	.2509E-01	81.0	.3855E-01	82.0	.3549E-01	83.0	.1346E-01
122908	84.0	-.6731E-02	85.0	-.9790E-02	86.0	.2448E-02	87.0	.1407E-01
+	88.0	.1713E-01	89.0	.1652E-01	90.0	.1774E-01	91.0	.2509E-01
+	92.0	.3549E-01	93.0	.3671E-01	94.0	.2203E-01	95.0	.9178E-02
122909	96.0	.4895E-02	97.0	.3059E-02	98.0	-.2448E-02	99.0	-.9790E-02
+	100.0	-.4283E-02	101.0	.1407E-01	102.0	.4589E-01	103.0	.5446E-01
+	104.0	.3059E-01	105.0	.4283E-02	106.0	-.4895E-02	107.0	.5507E-02
122910	108.0	.9178E-02	109.0	.9178E-02	110.0	.9178E-02	111.0	.1407E-01
+	112.0	.2325E-01	113.0	.2142E-01	114.0	.1713E-01	115.0	.2448E-01
+	116.0	.2692E-01	117.0	.2142E-01	118.0	.4283E-02	119.0	-.9178E-02
122911	120.0	-.6119E-02	121.0	.1346E-01	122.0	.2448E-01	123.0	.2631E-01
+	124.0	.1652E-01	125.0	.1285E-01	126.0	.2325E-01	127.0	.2815E-01
+	128.0	.2019E-01	129.0	.1101E-01	130.0	.6731E-02	131.0	.1163E-01
122912	132.0	.1040E-01	133.0	.1224E-02	134.0	-.6731E-02	135.0	.7954E-02
+	136.0	.3059E-01	137.0	.4344E-01	138.0	.3549E-01	139.0	.1163E-01
+	140.0	.6731E-02	141.0	.1163E-01	142.0	.1774E-01	143.0	.5507E-02
122913	144.0	-.5507E-02	145.0	-.3671E-02	146.0	.1713E-01	147.0	.3304E-01
+	148.0	.2203E-01	149.0	.4895E-02	150.0	.3059E-02	151.0	.1836E-01
+	152.0	.3732E-01	153.0	.3855E-01	154.0	.1407E-01	155.0	-.1713E-01
122914	156.0	-.2570E-01	157.0	-.1224E-02	158.0	.3182E-01	159.0	.4895E-01
+	160.0	.4283E-01	161.0	.1530E-01	162.0	-.6731E-02	163.0	-.7954E-02
+	164.0	.1836E-02	165.0	.2264E-01	166.0	.3243E-01	167.0	.3243E-01
122915	168.0	.2019E-01	169.0	.7954E-02	170.0	.1224E-02	171.0	.1224E-02
+	172.0	.6731E-02	173.0	.1469E-01	174.0	.2386E-01	175.0	.2019E-01
+	176.0	.1958E-01	177.0	.1530E-01	178.0	.1774E-01	179.0	.2019E-01
122916	180.0	.2509E-01	181.0	.2203E-01	182.0	.1163E-01	183.0	-.2448E-02
+	184.0	-.9790E-02	185.0	-.1224E-02	186.0	.1958E-01	187.0	.3610E-01
+	188.0	.3427E-01	189.0	.2570E-01	190.0	.1836E-01	191.0	.1774E-01
122917	192.0	.9178E-02	193.0	.5507E-02	194.0	.7343E-02	195.0	.1407E-01
+	196.0	.2019E-01	197.0	.1346E-01	198.0	.5507E-02	199.0	.3671E-02
+	200.0	.1346E-01	201.0	.2386E-01	202.0	.2876E-01	203.0	.2386E-01
122918	204.0	.1958E-01	205.0	.1897E-01	206.0	.1101E-01	207.0	-.4283E-02
+	208.0	-.4283E-02	209.0	.1530E-01	210.0	.3182E-01	211.0	.2753E-01
+	212.0	.1163E-01	213.0	.3059E-02	214.0	.8566E-02	215.0	.1897E-01
122919	216.0	.2998E-01	217.0	.2325E-01	218.0	.9178E-02	219.0	.6119E-03
+	220.0	.1040E-01	221.0	.1897E-01	222.0	.2325E-01	223.0	.1774E-01
+	224.0	.9178E-02	225.0	.7343E-02	226.0	.2142E-01	227.0	.3243E-01
122920	228.0	.2753E-01	229.0	.1652E-01	230.0	.0000E+00	231.0	-.1101E-01
+	232.0	-.6119E-02	233.0	.1530E-01	234.0	.2998E-01	235.0	.3243E-01
+	236.0	.1713E-01	237.0	.7343E-02	238.0	.9790E-02	239.0	.2325E-01
122921	240.0	.3243E-01	241.0	.2448E-01	242.0	.1224E-02	243.0	-.5507E-02
+	244.0	.6731E-02	245.0	.3059E-01	246.0	.3182E-01	247.0	.1163E-01
+	248.0	-.1101E-01	249.0	-.4283E-02	250.0	.2019E-01	251.0	.4344E-01
122922	252.0	.4773E-01	253.0	.2019E-01	254.0	-.7343E-02	255.0	-.2264E-01
+	256.0	-.2448E-02	257.0	.3549E-01	258.0	.5262E-01	259.0	.3610E-01
+	260.0	.6119E-03	261.0	-.1224E-01	262.0	.6119E-03	263.0	.1897E-01
122923	264.0	.2448E-01	265.0	.1530E-01	266.0	.1652E-01	267.0	.2264E-01
+	268.0	.2815E-01	269.0	.2448E-01	270.0	.6731E-02	271.0	-.4895E-02
+	272.0	-.1224E-02	273.0	.1652E-01	274.0	.2815E-01	275.0	.2815E-01
122924	276.0	.1530E-01	277.0	.9790E-02	278.0	.1346E-01	279.0	.1958E-01
+	280.0	.1958E-01	281.0	.1591E-01	282.0	.1101E-01	283.0	.4283E-02
+	284.0	.7954E-02	285.0	.1285E-01	286.0	.1346E-01	287.0	.8566E-02
122925	288.0	.2080E-01	289.0	.3794E-01	290.0	.3916E-01	291.0	.1530E-01
+	292.0	-.6731E-02	293.0	-.2448E-02	294.0	.1652E-01	295.0	.2692E-01
+	296.0	.1836E-01	297.0	.6731E-02	298.0	.5507E-02	299.0	.7343E-02
122926	300.0	.7954E-02	301.0	.1101E-01	302.0	.2203E-01	303.0	.3610E-01
+	304.0	.3855E-01	305.0	.2631E-01	306.0	.9178E-02	307.0	.0000E+00
+	308.0	.6119E-03	309.0	.3059E-02	310.0	-.6119E-03	311.0	.0000E+00
122927	312.0	.1224E-01	313.0	.3610E-01	314.0	.4834E-01	315.0	.3671E-01
+	316.0	.9790E-02	317.0	-.6119E-02	318.0	.6119E-03	319.0	.1163E-01
+	320.0	.1163E-01	321.0	.3059E-02	322.0	.1836E-02	323.0	.1407E-01

122928	324.0	.3059E-01	325.0	.3304E-01	326.0	.1836E-01	327.0	-.1224E-02
+	328.0	.6119E-03	329.0	.2386E-01	330.0	.4161E-01	331.0	.3549E-01
+	332.0	.9790E-02	333.0	-.1101E-01	334.0	-.1040E-01	335.0	.7954E-02
122929	336.0	.1774E-01	337.0	.1163E-01	338.0	.8566E-02	339.0	.2142E-01
+	340.0	.3671E-01	341.0	.3610E-01	342.0	.2570E-01	343.0	.1346E-01
+	344.0	-.2448E-02	345.0	-.1224E-02	346.0	.3059E-02	347.0	.4895E-02
122930	348.0	.1897E-01	349.0	.3243E-01	350.0	.2753E-01	351.0	.1285E-01
+	352.0	.5507E-02	353.0	.1224E-01	354.0	.2264E-01	355.0	.2692E-01
+	356.0	.1897E-01	357.0	.1836E-02	358.0	-.5507E-02	359.0	.2448E-02
122931	360.0	.2264E-01	361.0	.3671E-01	362.0	.2203E-01	363.0	.3671E-02
+	364.0	.6119E-02	365.0	.2570E-01	366.0	.3671E-01	367.0	.2937E-01
+	368.0	.1224E-02	369.0	-.1713E-01	370.0	-.1224E-01	371.0	.1591E-01
122932	372.0	.3977E-01	373.0	.5140E-01	374.0	.3427E-01	375.0	.2448E-02
+	376.0	-.1836E-01	377.0	-.1224E-01	378.0	.1652E-01	379.0	.4100E-01
+	380.0	.4222E-01	381.0	.2448E-01	382.0	-.6119E-02	383.0	-.2142E-01
122933	384.0	-.7954E-02	385.0	.2019E-01	386.0	.3977E-01	387.0	.3794E-01
+	388.0	.2080E-01	389.0	.5507E-02	390.0	.4895E-02	391.0	.1897E-01
+	392.0	.3059E-01	393.0	.3059E-01	394.0	.1836E-01	395.0	.2448E-02
122934	396.0	-.6119E-03	397.0	.1224E-02	398.0	.5507E-02	399.0	.7343E-02
+	400.0	.9790E-02	401.0	.2386E-01	402.0	.3671E-01	403.0	.3059E-01
+	404.0	.1469E-01	405.0	.6119E-03	406.0	.6119E-02	407.0	.3121E-01
122935	408.0	.3427E-01	409.0	.1774E-01	410.0	.1224E-02	411.0	-.1224E-02
+	412.0	.5507E-02	413.0	.1774E-01	414.0	.2080E-01	415.0	.1469E-01
+	416.0	.7343E-02	417.0	.1163E-01	418.0	.2753E-01	419.0	.3059E-01
122936	420.0	.2142E-01	421.0	.3671E-02	422.0	-.3059E-02	423.0	.9790E-02
+	424.0	.2142E-01	425.0	.2876E-01	426.0	.2325E-01	427.0	.1469E-01
+	428.0	.9178E-02	429.0	-.3059E-02	430.0	.1836E-02	431.0	.1958E-01
122937	432.0	.4589E-01	433.0	.4406E-01	434.0	.1774E-01	435.0	-.1101E-01
+	436.0	-.1897E-01	437.0	-.6119E-03	438.0	.2448E-01	439.0	.3549E-01
+	440.0	.3182E-01	441.0	.2080E-01	442.0	.8566E-02	443.0	-.7343E-02
122938	444.0	-.1101E-01	445.0	.1407E-01	446.0	.3977E-01	447.0	.5813E-01
+	448.0	.4895E-01	449.0	.1224E-01	450.0	-.2080E-01	451.0	-.3427E-01
+	452.0	-.1346E-01	453.0	.1897E-01	454.0	.4834E-01	455.0	.5017E-01
122939	456.0	.2570E-01	457.0	.3671E-02	458.0	.3671E-02	459.0	.1285E-01
+	460.0	.2019E-01	461.0	.1469E-01	462.0	.6119E-02	463.0	.3671E-02
+	464.0	.1530E-01	465.0	.2692E-01	466.0	.2570E-01	467.0	.1469E-01
122940	468.0	.9790E-02	469.0	.2386E-01	470.0	.3121E-01	471.0	.1958E-01
+	472.0	.3059E-02	473.0	-.6119E-02	474.0	-.8566E-02	475.0	.6731E-02
+	476.0	.2509E-01	477.0	.3732E-01	478.0	.3488E-01	479.0	.2386E-01
122941	480.0	.1285E-01	481.0	.8566E-02	482.0	.1407E-01	483.0	.1652E-01
+	484.0	.1774E-01	485.0	.8566E-02	486.0	-.6119E-03	487.0	-.7343E-02
+	488.0	.1163E-01	489.0	.2876E-01	490.0	.3243E-01	491.0	.2080E-01
122942	492.0	.1346E-01	493.0	.1163E-01	494.0	.1285E-01	495.0	.1285E-01
+	496.0	.1346E-01	497.0	.1713E-01	498.0	.1530E-01	499.0	.1836E-01
+	500.0	.1346E-01	501.0	.1591E-01	502.0	.1591E-01	503.0	.1346E-01
122943	504.0	.1285E-01	505.0	.1530E-01	506.0	.2264E-01	507.0	.1346E-01
+	508.0	.3671E-02	509.0	.4283E-02	510.0	.1958E-01	511.0	.3610E-01
+	512.0	.2386E-01	513.0	.7343E-02	514.0	-.5507E-02	515.0	-.6119E-03
122944	516.0	.2264E-01	517.0	.4222E-01	518.0	.3610E-01	519.0	.1163E-01
+	520.0	-.1713E-01	521.0	-.2142E-01	522.0	.1101E-01	523.0	.4589E-01
+	524.0	.5323E-01	525.0	.3243E-01	526.0	.6119E-03	527.0	-.1040E-01
122945	528.0	.6731E-02	529.0	.2080E-01	530.0	.2631E-01	531.0	.1958E-01
+	532.0	.9790E-02	533.0	-.6119E-03	534.0	.3671E-02	535.0	.1652E-01
+	536.0	.2998E-01	537.0	.2631E-01	538.0	.1101E-01	539.0	.9790E-02
122946	540.0	.2570E-01	541.0	.3671E-01	542.0	.2325E-01	543.0	-.1836E-02
+	544.0	-.1713E-01	545.0	-.7343E-02	546.0	.1652E-01	547.0	.3794E-01
+	548.0	.4711E-01	549.0	.3671E-01	550.0	.9178E-02	551.0	-.7954E-02
122947	552.0	-.1101E-01	553.0	.6119E-02	554.0	.2203E-01	555.0	.2692E-01
+	556.0	.2448E-01	557.0	.2570E-01	558.0	.2080E-01	559.0	.6119E-02
+	560.0	-.2448E-02	561.0	.0000E+00	562.0	.1407E-01	563.0	.3182E-01
122948	564.0	.3549E-01	565.0	.2815E-01	566.0	.1407E-01	567.0	.6119E-03
+	568.0	.7343E-02	569.0	.1469E-01	570.0	.1469E-01	571.0	.6119E-02
+	572.0	.1836E-02	573.0	.9178E-02	574.0	.2080E-01	575.0	.2815E-01
122949	576.0	.2815E-01	577.0	.2815E-01	578.0	.2142E-01	579.0	.1101E-01
+	580.0	.7954E-02	581.0	.3059E-02	582.0	.7954E-02	583.0	.1774E-01
+	584.0	.2264E-01	585.0	.1346E-01	586.0	.1836E-02	587.0	-.3059E-02
122950	588.0	.1897E-01	589.0	.3304E-01	590.0	.2753E-01	591.0	.2019E-01
+	592.0	.1591E-01	593.0	.1652E-01	594.0	.1224E-01	595.0	.1836E-02
+	596.0	.4283E-02	597.0	.1285E-01	598.0	.2386E-01	599.0	.2325E-01
122951	600.0	.1224E-01	601.0	.9178E-02	602.0	.1652E-01	603.0	.2509E-01
+	604.0	.2264E-01	605.0	.1346E-01	606.0	.0000E+00	607.0	.6119E-03
+	608.0	.1469E-01	609.0	.2937E-01	610.0	.3365E-01	611.0	.2386E-01
122952	612.0	.5507E-02	613.0	-.5507E-02	614.0	-.1224E-02	615.0	.1897E-01
+	616.0	.3365E-01	617.0	.2998E-01	618.0	.1163E-01	619.0	-.7343E-02
+	620.0	-.2448E-02	621.0	.2142E-01	622.0	.3855E-01	623.0	.3549E-01
122953	624.0	.1897E-01	625.0	-.4895E-02	626.0	-.1285E-01	627.0	-.3059E-02
+	628.0	.2142E-01	629.0	.4344E-01	630.0	.4528E-01	631.0	.2937E-01
+	632.0	.1101E-01	633.0	-.7954E-02	634.0	-.1163E-01	635.0	.3059E-02
122954	636.0	.2509E-01	637.0	.3549E-01	638.0	.2448E-01	639.0	.5507E-02
+	640.0	.1224E-02	641.0	.1407E-01	642.0	.2386E-01	643.0	.2142E-01

+	644.0	.1285E-01	645.0	.9178E-02	646.0	.1346E-01	647.0	.2509E-01
122955	648.0	.2019E-01	649.0	.1285E-01	650.0	-.6119E-03	651.0	.4283E-02
+	652.0	.1652E-01	653.0	.2876E-01	654.0	.3671E-01	655.0	.2815E-01
+	656.0	.1652E-01	657.0	-.3059E-02	658.0	-.8566E-02	659.0	-.6119E-03
122956	660.0	.1469E-01	661.0	.2692E-01	662.0	.2509E-01	663.0	.1897E-01
+	664.0	.1285E-01	665.0	.2142E-01	666.0	.2815E-01	667.0	.2753E-01
+	668.0	.8566E-02	669.0	-.6119E-03	670.0	.1836E-02	671.0	.1774E-01
122957	672.0	.2142E-01	673.0	.8566E-02	674.0	-.2448E-02	675.0	.7343E-02
+	676.0	.3304E-01	677.0	.4406E-01	678.0	.2570E-01	679.0	.6119E-02
+	680.0	.3671E-02	681.0	.1713E-01	682.0	.2509E-01	683.0	.1407E-01
122958	684.0	-.1224E-02	685.0	.3059E-02	686.0	.1652E-01	687.0	.2753E-01
+	688.0	.2386E-01	689.0	.1591E-01	690.0	.9790E-02	691.0	.1040E-01
+	692.0	.1530E-01	693.0	.1224E-01	694.0	.1346E-01	695.0	.1774E-01
122959	696.0	.2080E-01	697.0	.1958E-01	698.0	.1897E-01	699.0	.1163E-01
+	700.0	.9178E-02	701.0	.7954E-02	702.0	.1652E-01	703.0	.3243E-01
+	704.0	.3365E-01	705.0	.1652E-01	706.0	-.9178E-02	707.0	-.1469E-01
122960	708.0	-.6119E-03	709.0	.2509E-01	710.0	.3610E-01	711.0	.2692E-01
+	712.0	.2019E-01	713.0	.1836E-01	714.0	.2631E-01	715.0	.1774E-01
+	716.0	-.1836E-02	717.0	-.6119E-03	718.0	.1346E-01	719.0	.3365E-01
122961	720.0	.2692E-01	721.0	.4283E-02	722.0	-.4895E-02	723.0	.6119E-03
+	724.0	.1774E-01	725.0	.2815E-01	726.0	.2631E-01	727.0	.2325E-01
+	728.0	.2815E-01	729.0	.1530E-01	730.0	.6731E-02	731.0	.4283E-02
122962	732.0	.1163E-01	733.0	.2631E-01	734.0	.2264E-01	735.0	.8566E-02
+	736.0	-.9790E-02	737.0	-.5507E-02	738.0	.1774E-01	739.0	.4589E-01
+	740.0	.5017E-01	741.0	.2142E-01	742.0	-.3059E-02	743.0	-.1040E-01
122963	744.0	.8566E-02	745.0	.1958E-01	746.0	.1713E-01	747.0	.1346E-01
+	748.0	.1407E-01	749.0	.1774E-01	750.0	.1407E-01	751.0	.1713E-01
+	752.0	.2264E-01	753.0	.1897E-01	754.0	.1407E-01	755.0	.1346E-01
122964	756.0	.1224E-01	757.0	.9178E-02	758.0	.3059E-02	759.0	.3671E-02
+	760.0	.8566E-02	761.0	.2019E-01	762.0	.2386E-01	763.0	.2753E-01
+	764.0	.3243E-01	765.0	.2753E-01	766.0	.6731E-02	767.0	-.1163E-01
122965	768.0	-.7343E-02	769.0	.1897E-01	770.0	.4100E-01	771.0	.3977E-01
+	772.0	.1530E-01	773.0	-.1224E-01	774.0	-.1958E-01	775.0	.6119E-03
+	776.0	.3304E-01	777.0	.5691E-01	778.0	.4711E-01	779.0	.1224E-01
122966	780.0	-.1836E-01						

, END OF DATA

ERRATA

JAERI-M 91-226

DEVELOPMENT OF ANALYSIS CODE FOR THERMAL HYDRO-DYNAMICS OF MARINE REACTOR UNDER MULTI-DIMENSIONAL SHIP MOTIONS, RETRAN-02/GRAV

(IMPROVEMENT OF RETRAN-02 AND EXPERIMENTAL ANALYSES)

Some words are typed in duplicate in sentences of Chapter Two in the report, JAERI-M 91-226. They should be eliminated as follows:

(page)	(line)	(to be eliminated:underlined words)
4	4	... code and <u>by</u>
4	9	... were listed <u>in</u>
4	16	... a number of <u>control</u>
4	17	... equations <u>for</u>
4	24	... inflow at <u>point</u>
4	25	... equation <u>of</u>
5	15	... energy <u>for</u>
5	17	... is <u>given</u>
6	6	... momentum <u>flux,</u>
6	8	... and the <u>eighth</u>
6	9	... tenth <u>terms</u>
6	19	... the <u>vertical</u>
6	25	... as shown <u>in</u>
7	6	... will <u>have</u>
7	7	... is <u>inclined</u>
7	8	... between <u>upper</u>
7	9	... : The <u>volume</u>

7	10	... and to
7	14	... than the water
7	15	... is lower
7	16	... occur that
7	18	... that an
7	23	... be modified
7	24	... center of
8	1	... height from a
8	4	... The blank circle
8	5	... the geometric
8	6	... junction connected
8	7	... CMAS is the
8	9	... ,from
8	10	... . We
8	12	... is given using
8	17	... the right side
8	18	... RETRAN code
8	23	... position goes
8	25	... bottom of
9	2	... should be
9	6	... level is
9	7	... . Steam
9	9	... the water
9	18	... vertical acceleration.
10	8	... acceleration g(t), we
10	11	... , we obtain,
11	8	... by even gravitational
11	12	... original RETRAN
11	16	... energy term in

End