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The Operational Experience at Tokai Reprocessing Plant

-Record of Oral Presentation at RECOD '91-

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POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORPORATION

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The Operational Experience at Tokai Reprocessing Plant
東海再処理工場での運転経験

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要　旨

仙台において，１９９１年4月１５日から4月１８日にかけて，燃料再処理及び廃棄物の取扱に関する第3回国際会議”ＲＥＣＯＤ’９１”が，海外からの参加者１６０名を含め約６２０名の参加のもと開催された。本会議において，山村　再処理副工場長から”東海再処理工場の運転経験”と題した口頭発表を行った。発表では，１９７１年に東海再処理工場の建設を開始してから今日までの経緯の概要を説明すると共に，特に，１９８８年から１９８９年にかけて行った計画停止期間中の改良工事及びその結果，更に，東海工場の将来展望等について説明を行った。本レポートは，この発表に用いた予稿及び口頭発表原稿並びにスライド原稿を取りまとめたものである。

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Abstract

This paper is compiled as a record of oral presentation by O.YAMAMURA at RECOD'91 in April 15.1991 in Sendai Japan with more than 600 attendance. It contains a proceeding, a manuscript of oral presentation and a manuscript of viewgraphs. The abstract of presentation is as belows.

Since the start of construction of the Tokai Reprocessing Plant (TRP) in 1971, large efforts were taken by the Power Reactor and Nuclear Fuel Development Corporation (PNC) and various organizations to root the LWR fuel reprocessing technology in Japan. These efforts produced many achievements around the TRP, and now the future plan for the TRP is being studied.

Contents

1. Foreword

The Third International Conference on Nuclear Fuel Reprocessing and Waste Management titled "RECOD'91" was held in Sendai Japan in the period of April 14~18, 1991. More than 600 people participated in this meeting and more than 200 papers were presented.

Deputy Director of TRP, O.YAMAMURA, presented mainly concerned with the chronolgy and the technolgical modification of TRP, titled "THE OPERATIONAL EXPERIENCE AT TOKAI REPROCESSING PLANT".

This paper is compiled as a record of oral presentiation.

2. Proceeding

THE OPERATIONAL EXPERIENCE AT TOKAI REPROCESSING PLANT

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ABSTRACT

Since the start of construction of the Tokai Reprocessing Plant(TRP) in 1971, large efforts were taken by the Power Reactor and Nuclear Fuel Development Corporation(PNC) and various organizations to root the LWR fuel reprocessing technology in Japan. These efforts produced many achievements around the TRP, and now the future plan for the TRP is being studied.

1. Introduction

The PNC has been operating the TRP since Sept. 1977 when the plant became active status using the spent fuel from the Japan Power Demonstration Reactor(JPDR), and the total amount of reprocessed fuels is exceeded over 500 tons. This amount is next to French achievement in the field of oxide spent fuel reprocessing.

Through these experiences of plant operation, we demonstrated, improved and established the mechanical head-end process and Purex process in Japan.

From the beginning of plant operation, the project to reduce the activities released to environment was started, and the number of facilities were add to the TRP. The actual values of radioactive release to environment have been quite low. During this period, a lot of corrosion problems of important equipments were occurred, which had not been exactly foreseen. On each occasion, the phenomena of corrosion were investigated, new corrosion resistant material was developed, and the procedure for fabrication and welding has been modified and improved step by step.

Recently, the scheduled long period of shut-down of plant operation was set to replace and modify the plant equipments for prevention of sudden equipment failure and for increase of reprocessed amount. The result of major maintenances improved the plant performance satisfactory.

Above mentioned activities were carried out with the participation of domestic industries using the own developed technique, therefore,the reprocessing technique was rooted in Japan and infra-structure of it was established. As for the development of fast breeder reactor(FBR) fuel reprocessing, which has been started from the beginning of 1970, the experiences of TRP operation become the one of design data-base for this project.

Concerning the cooperation with Japan Nuclear Fuel Services(JNFS), the "Basic Agreement between PNC and JNFS for the Technical Cooperation" was signed between both organizations in 1982, and various cooperations are being carried out such as consultation of design, dispatching of engineers, joint R&D activities, contracted projects, etc..

As a summary, the TRP has a key position for the development of technology of LWR fuel reprocessing, FBR fuel reprocessing,waste treatment, and for the realization of commercial reprocessing in Japan.

2.History of TRP

2.1 Construction and Test Campaigns

The reprocessing project of the PNC was started in September 1956 when the Atomic Energy Commission(AEC) of Japan decided that reprocessing of spent fuel and treatment of radioactive waste should mainly be done by the Atomic Fuel Corporation(AFC), the predecessor of PNC. In 1959, an Advisory Committee for reprocessing was formed within the AEC to formulate a guideline for development of the reprocessing technology. In conjunction with the recommendations put forward by a survey team which visited overseas reprocessing plants, a decision was made to construct a pilot reprocessing plant using the advanced technology developed by other countries.

In 1963, the AFC entered into a contract with the Nuclear Chemical Plant(NCP) of UK for a preliminary design of the plant, and in 1966 a detailed design was started by the Société Générale pour les Techniques Nouvelles(SGN) of France. Since 1968 and in parallel with the ongoing detailed design, the governmental licensing procedure had been followed and permission for plant construction was granted by the Japanese Government in 1970.

Plant construction was started in 1971 as a joint venture of SGN-JGC of Japan. The Plant was completed in 1974 and hot testing started in September 1977 after completing the U testing using unirradiated uranium. Up to the end of 1990 the total amount of reprocessed fuel from LWRs and the ATR Fugen(Advanced thermal reactor using heavy water as the moderator) was about 500 tons.

2.2 Reprocessed Fuel

The total reprocessed fuels from the start of hot operation on 22nd of September 1977 to the end of 1990 is about 509 ton of oxide spent fuel. The number of spent fuel assembly and amount of spent fuel is as follows, BWR:1815 and 321.1 tons, PWR:500 and 183.1 tons, and ATR Fugen Mixed Oxide Fuel:34 assemblies of 5 tons, which gave us valuable experiences for MOX fuel reprocessing.

The amount of plutonium nitrate recovered as a final product was about 3.4 tons, and most of Pu has already been sent to Pu conversion plant for use at the ATR Fugen, the experimental FBR Joyo, and proto-type FBR Monju.

2.3 Major Maintenance Activities

(1) Remote Repair of Dissolver R10 and R11

In April 1982, a small amount of radioactivity was found in the steam condensate from a dissolver. After confirming that one of the two dissolvers R11 had small defects which consist of pin holes in the welded part on the barrel of dissolver, operation was resumed using R10 dissolver until February 1983 when dissolver R10 had same kind of defects. The remote repair technology had been developed, and from September to November 1983 the in-situ repair of two dissolvers was carried out successfully first time in the world.

(2) Installation of New Dissolver R12

Leakages in the two dissolvers occurred rather unexpectedly and subsequently the third dissolver was installed in a spare dissolver cell.

Table 1. Total Reprocessed Fuel at TRP

	Number of Assembly	Reprocessed Uranium (MTU)	Maximum Burnup (MWD/T)	Average Burnup (MWD/T)	Cooling Time (Years)
BWR	1,815	321.1	29,800	18,300	0.9-21.2
PWR	500	183.1	34,500	22,200	0.9-17.1
Fugen(ATR)	34	5.2	13,500	9,800	3.3-6.0
Total	2,349	509.4	34,500	19,600	0.9-21.2

A new dissolver R12 was fabricated with improved material and welded lines were eliminated from the inside steam jacket as for the design. A fabrication of dissolver was finished in April 1984, and was installed by the end of November 1984.

(3)Repair of Acid Recovery Evaporator

During the final stage of hot testing in August of 1977, a minor leak was detected which was caused by pin holes of welded part of heating tube in the acid recovery evaporator, and an exchange of whole part of evaporator was done after decontamination and dismantling of leaked evaporator by the end of December 1979. However, the new one leaked again in February 1983 caused by corrosion of heating tube, and at that occasion only boiler part of evaporator was replaced with domestic produced materials. The repairing period was seven months which was shorter compared with former one.

3. Present Status

3.1 Scheduled Shut-down of Plant Operation

The operation of TRP became steady and stable since 1985 after many modifications and improvements, however, the requirement of increasing the reprocessed amount at the TRP is stronger than before because of demand for more plutonium of the ATR and FBR fuel cycle development.

The design capacity of TRP is 0.7 tons per day, and operational license permits the TRP to reprocess up to 210 tons per year. Although it was difficult to reach this maximum, because of yearly regulatory inspection, the physical inventory takings(PIT) of nuclear material and periodical maintenance works. The operational total days of TRP per year had been calculated as about 170 days, and assuming the average plant efficiency factor of 60% the derived yearly production of TRP had been about 70 tons.

For the improvement of the production rate, one is augmentation of operation days and another is to ameliorate the plant performance factor. The operational yearly days were increased by shortening of maintenance and regulatory inspection period, and for the plant efficiency factor, it became clear to improve and modify the fuel assembly shearing process and clarification process for dissolved fuel solution. In the long range, it was also obvious to prevent the sudden stop of plant operation, which will be caused by failure of major equipment due to corrosion. Therefore the scheduled shut-down of plant operation was set to replace the acid recovery evaporator, and to make modification of fuel assembly shearing process, clarification process etc..

3.2 The Major Maintenance Works During the Scheduled Shut-down Period

(1)The Replacement of the Acid Recovery Evaporator

The first acid recovery evaporator leaked in 6000 hours of use, and the leak of second one was occurred in 13,000 hours use. The material of evaporator was 25%-chromium and 20%-nickel alloy of stainless steel, and the conservative estimation was that the third evaporator would leak again in 13,000 hours of use, which was expected around the half of 1988. On the other hand, the development of corrosion resistant material was done continuously since the day of leak of first evaporator, and it became evident that the titanium and 5%-tantalum alloy material shows a good corrosion resistance behavior in this corrosive environment.

The decision was taken to replace the third evaporator with the new one made of Ti-5%Ta alloy. This work was started in June 1988 and was performed smoothly within scheduled 11 months period, based on the old experiences of two times replacement so far.

(2)The Replacement of Plutonium Solution Evaporator

The design of original plutonium evaporator was to connect the washing column to boiler part with the flange, and the material of former one was stainless steel and latter one was corrosion resistant titanium. For the column part a pin hole defect appeared in year 1982 after 10,000 hours of operation and in-situ repair was done. In year 1984 the replacement of whole evaporator was done after 12,000 hours of operation.

The decision was made to replace this evaporator because of 9,000 hours of operation, and the material of column part was chosen as Ti-5%Ta alloy to prolong the operational life. The improvement was made to remove the flange connection by welding the titanium and Ti-5%Ta alloy. The replacement was done in the cell within three months.

(3)Modification of Boiler part of Acid Recovery Distillator

The acid recovery distillator was fabricated from the stainless steel, and in February 1981 the corrosion leakage was occurred on the part of heating coil after 13,000 hours of use, and repair work was done within 1.5 months. In 1984 the boiler part of distillator was replaced within 4 months.

The new distillator was installed to replace the old one which operation time was about 13,000 hours of use. The new distillator has separable heating tubes from boiler part of distillator for easy maintenance.

(4)Modification of Fuel Assembly Shearing Machine
Many modification works for internal parts of shearing machine were done to improve the operability and maintenance ability.

(5)The Addition of Second Pulsed Filter
The clarification method of the TRP was to use pulsed filter. The filtration of dissolver solution clogs the sintered stainless filter gradually and finally it will necessitate the replacement of filter cartridge affecting the plant.

To improve the plant efficiency factor, the second pulsed filter was added in the clarification process. The new type of valve for changing use of both filters was developed to install inside cell for easy maintenance and high fidelity. The modification works inside cell was done after tedious decontamination of equipments and piping, and working time was limited because of still rather high radiation dose. The time of total installation work was more than one year after delay of four months for final modifications.

3.3 Evaluation of Major Modifications on Plant Performance

The scheduled shut-down of plant operation continued 15 months, and the PNC person who is involved in this work were around 500 and the number of contracted workers of constructor and engineering firms were about 1,600(about 100,000 man-day). The accumulated radiation dose of person was 5 man•Sv(500 man•rem), which is higher than average 1-2 man•Sv/year of record of the TRP operational staff exposure rate.

The original intention of improving the plant was to increase the yearly processing amount from 70 tons to 90 tons. The start of operation from the major modification works was in the end of September 1989 and after one year in September 1990 the reprocessed amount was 83 tons of spent fuel and during the year 1990 from January to end of November 99 tons of fuel was reprocessed.

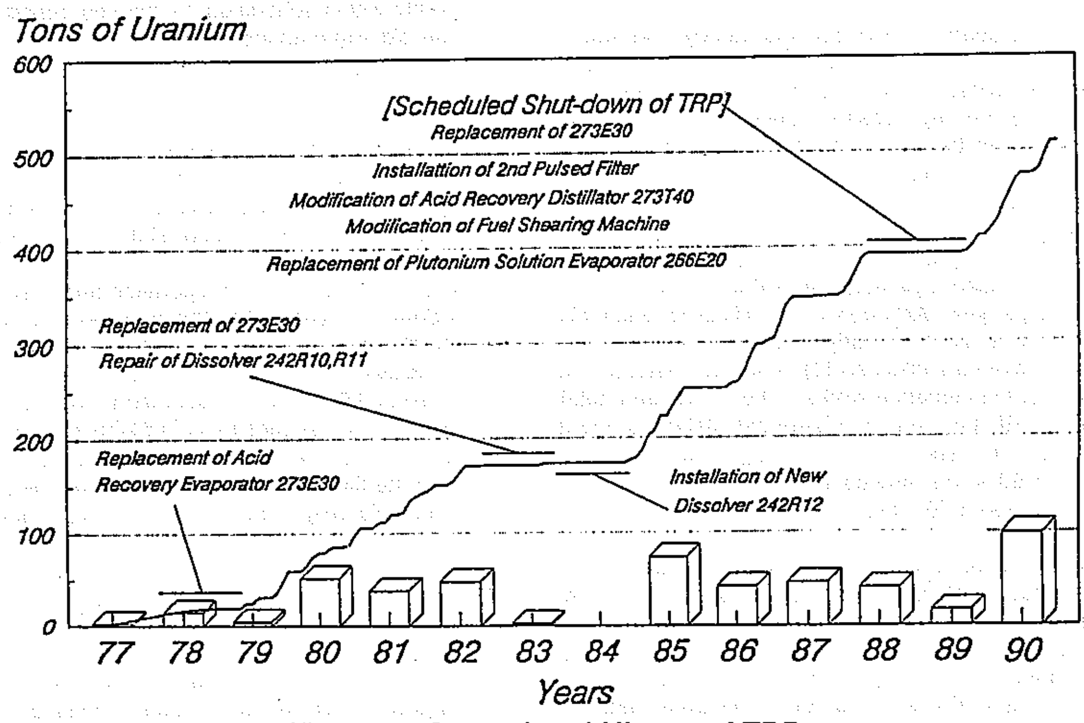

Figure 1. Operational History of TRP

4. Developments of Reprocessing Technology

4.1 The Achievements of R&D Activity

The main process of TRP was designed by SGN in the latter part of 1960s, when the experiences of LWR fuel reprocessing were very limited in the world, and the TRP had to encounter many difficulties from the start of construction, hot test and regular operation.

These difficulties were solved one by one at the TRP with cooperations of many people and organizations, and through theses efforts the many successful results of R&D were obtained such as:

(1)Fluidized denitration technique of uranyl nitrate solution to uranium tri-oxide powder

(2)Waste evaporation treatment technique for reducing the activity release to sea and de-oiling technique from the discharge liquid by charcoal filtration.

(3)Solidification for concentrated waste and used solvent by bitumen and plastic

(4)Development of new corrosion resistant materials and fabrication technique for the use in the corrosive environment

(5)Remote maintenance and repair technique in the high radiation area

(6)Preventive and removal technique for the clogging of piping caused by sludge

(7)Advanced operation support systems using computers

Furthermore, the one of most important achievement at the TRP is in the area of Safeguards(SG) of nuclear material. The plant start-up schedule was somewhat influenced by the negotiations between the govermment of United States of America and Japan. After both governments had agreed on the terms and conditions of plant operation, the first hot campaign was started. The TRP was regularly inspected by IAEA as well as Science Technology Agency(STA),and international SG project was done as the Tokai Advanced Safeguards Technology Exercise(TASTEX) from year 1978 to 1981 which have been followed by the Japan Support Program for Agency Safeguards(JASPAS).

In last July 1990 PNC received the Industrial Award of Institute of Nuclear Material Management(INMM) for the peaceful use of plutonium and efforts for development of SG technique.

4.2 Future Plan for R&D

The R&D activities at the TRP until now are primarily aiming at keeping steady operation, and the before mentioned schedule shut-down of plant operation was for the concentrated measures to expect the stable and improved operation.

From now the purpose of R&D activity of TRP shall be toward more advanced and sophisticated areas compared before. The main items of interest are as follows:

(1)Advanced Technique for Reprocessing of High Burn-up Fuel

The burn-up specification of spent fuel reprocessed at the TRP is average 28,000 MWD/T per day of processing and Maximum 35,000 MWD/T per fuel assembly. Recently the project to increase the burn-up of LWR fuel is going on in Japan above 50,000 MWD/T, and also the demonstration program for plutonium(MOX) fuel recycling in LWR core is proceeding smoothly. The study is being done to reprocess these special fuel at the TRP by current purex method.

(2)Development of Remote Handling Technique

(i)The Development of Advanced Repair Machine for the Dissolvers

The improvement of remote repair machine is continued to widen the area of access inside the dissolver and to make a machine as a multi-function.

(ii)The Development of In Service Inspection(ISI) Equipment

The remote ISI equipment is needed to verify the soundness of high active liquid waste evaporator which is very difficult to access, also under developing equipment to check the drip trays in the cell.

(iii)The Remote Dismantling Technique of Dissolver

The operational life of dissolver will be limited for corrosion of material, and in case of failure not possible to repair by remote device, it will be necessary to remove the dissolver itself from the cell. The remote machine to do this work requires high standards of technique because of the complicated work to dismantle and remove the large, high active dissolver from a rather small cell.

(3)The Strengthening of Engineering Data-base

Concerning the various technical data which were acquired during the construction, operation and maintenance works, the data-base with computers is being developed for the use of operation and R&D activity. One of data-base is the Tokai Reprocessing Plant Maintenance and Management Support System(TORMASS) to store the specification of various equipments and the maintenance data, analyze the data and retrieve the data easily for maintenance schedule.

(4)Operational Support System for Main Process

The instruction system for operation of extraction process is under development to support operators. The process simulator of extraction process is also being developed to support instruction system. These activities will help the analysis of mal-operation and safety evaluation of reprocessing operation.

(5)Development of Head-end Facility

The head-end process which is composed of shearing, dissolution and clarification of spent fuel is one of critical part of reprocessing, and some new reprocessing plants have parallel lines on this part. Also at TRP, the head-end process is main area to lower the performance of plant and caused a frequent shut-down of operation. In other words, there remains many areas of improvements and developments for the head-end process, and the study to add a new head-end facility to the TRP is started to demonstrate the advanced equipments in hot environment.

As for the operation of Recycling Equipment Test Facility(RETF) which will be used for development of FBR fuel reprocessing technology, the active products and wastes produced from the experiment will be treated in the TRP connecting the both facilities with piping.

5. Conclusion

The design of main process of the TRP was made in abroad and the improvements and developments were done from the start of construction to today to accommodate the various situations in Japan. Around the TRP plutonium and uranium conversion facility, krypton recovery facility, bituminization facility and vitrification facility etc. were constructed and operated, and the development activities for back-end fuel cycle were concentrated at PNC Tokai site.

The initial aim of strengthening and stabilizing the operation of the TRP is now almost obtained, and the future plan for the TRP is to toward the R&D oriented areas.

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3. Manuscripts of oral presentation

The Operational Experience at Tokai Reprocessing Plant

Thank you Mr. Chairman :

In my presentation today,

__________ (Slide #1 : タイトル)

I would be focussing on the recent operation of TRP, Tokai Reprocessing Plant, following to the major maintenance works in 1988 through 1989, and the future plan about the TRP.

__________ (Slide #2 : ＴＲＰ年表)

The reprocessing project in PNC was started in the middle of 1950's, when the Atomic Energy Commission of Japan decided to do the reprocessing of spent fuels and treatment of radioactive waste in Japan, mainly by PNC. Also recommended was to introduce the reprocessing technology from overseas countries because of their reprocessing experiences at that time.

Based on the detailed design by SGN, France, the construction of TRP was carried out in 1971 through 1974, and was followed by the chemical test and uranium test. The hot test was started in 1977, after the vigorous negotiations between the governments of U.S.A and Japan. The pre-commissioning test for governmental inspection was carried out in 1980 according to the new law, and in the beginning of 1981, the regular operation of TRP was started.

__________ (Slide #3 : 処理グラフ)

Although, during the plant operation up to now, TRP has been faced quite serious situations, mainly due to corrosion of major equipment, Acid Recovery Evaporator, Dissolvers, and so on, we have overcome those problems one by one and continued plant operation. Anyway, we recognize that it is the fate of TRP, because, as you know, TRP is the first reprocessing plant in Japan, which should have some sort of characteristics of the pilot plant. Therefore, we have been trying to accumulate the technical know-hows through a lot of modifications and improvements, as well as plant operation, in terms of reliability or operability, and carrying out many R&Ds as a pilot plant, such as on the corrosion resistant materials, remote techniques, decreasing radioactive discharge into the sea, iodine removal, Kr recovery, waste solidifications, safeguards techniques, safety standards, etc., etc..

__________ (Slide #4 : ＴＲＰ写真)

This photograph shows recesnt Tokai Reprocessing Plant.

In Japan, the construction plan of JNFS reprocessing plant is going on now, which is a really commercial scale one, and aiming at the start-up in 1998. The cooperation agreement was signed between PNC and JNFS in 1982, and PNC has given positive aid through various cooperations, such as consultation of design and licensing including offer of TRP data, dispatching more than 50 engineers, joint R&D activities, and so on.

On the other hand, the FBR fuel reprocessing will be essential in near future in order to establish the plutonium utilization structure. Currently, PNC is recognized as the main body for the development of FBR fuel reprocessing technology, and this project is now one of the most important job in PNC. The process data and operational experience accumulated in TRP have been reflected to this project and consolidated the foundation.

As a summary, TRP has a key position for the development of LWR fuel reprocessing including waste treatment, realization of commercial reprocessing in Japan, and the development of FBR fuel reprocessing.

Okay, let me back to recent operation of TRP.

The operation of TRP has become rather steady and stable since the middle of 1980's, after many modifications and improvements. However, the requirement of increasing the reprocessing amount in TRP became stronger than before, because of demand for more plutonium for ATR, Advanced Thermal

Reactor, and FBR fuel cycle development.

__________(Slide #5 : 年間運転モード)

The design capacity of TRP is 0.7 tons per day, and the operational license permits to process up to 210 tons per year assuming 300 days operation annually. For improving reprocessing amount, one is to increase the annual operation days, and another is to improve the plant efficiency, what you call, availability.

This viewgraph shows annual operation days. The top bar-graph is of the middle of 1980's. It is quite difficult to reach the design value of 300 days-operation per year, because of the periodic inspection of the plant carried out by government annually, conducting twice Physical Inventory Taking, and periodic maintenance works. Actually, operation days was about 170 days per year at that time. As shown in bottom bar-graph, it has been increased to about 200 days since 1987 by shortening the time periods for maintenance and periodic inspection.

__________(Slide #6 : 稼働率ヒストグラム)

This histogram shows the distribution of campaign-basis plant efficiency so far. The averaged efficiency was about 58 %, which corresponded to about 70 tons per year.

__________(Slide #7 : 不調原因プロセス)

This viewgraph shows major process which interrupted the continuous operation of whole process. In TRP, almost all causes decreasing the plant efficiency have come from such process as shearing, clarification, and dissolution, or, in other words, the head-end process.

__________ (Slide #8 : 五大工事表)

Considering those situation in TRP, the scheduled shut-down period, with about one year, was set to improve the plant efficiency and reliability from long-term, as well as short-term viewpoint. The major maintenance works in this shut-down period are showed in this viewgraph. From the long-term viewpoint, three major equipments which process nitric acid solution with high temperature, such as Acid Recovery Evaporator, were replaced or modified in order to improve those reliability, in other words, long-term plant efficiency. Also, the modification of the internal parts of Shearing Machine and installation of Second Pulsed Filter were carried out to improve the operability, or short-term efficiency.

Now, let me look back quickly on these maintenance works.

__________ (Slide 9 : 酸回収蒸発缶)

First of all, the Acid Recovery Evaporator. This viewgraph illustrates the evaporator with about '8 meter high and weight of about 9 tons. We had experienced pin-hole failures twice due to corrosion at 6,000 and 13,000 hours operation, which caused about one year interruptions of the plant operation. For the preventive maintenance, this evaporator was replaced with a new one made of titunium-tantalum alloy, at about 13,000 hours operation.

__________(Slide #10： プル蒸発缶)

Also for the Plutonium Solution Evaporator, the tower portion was replaced. Although the evaporator itself is made of titunium, the tower was made of stainless steel and corrosion problems had appeared. The tower was replaced with titunium-tantalum alloy and the flange connection was modified to welding to improve the confinement.

__________(Slide #11： 酸回収精留塔)

Generally, the most critical part for corrosion of evaporators is the heat exchanging pipes. The Acid Recovery Distillator, showed in this viewgarph left, had faced pin-hole failures on the heating pipes several years ago. Since then, a worker had entered into the bottom of the distillator twice a year to check the heating pipes and repaired them, if needed. The configuration of the distillator was modified as right side of the viewgraph, for easier maintenance of the heating tubes, by taking out them as a tube bundle.

__________(Slide #12： 剪断機)

Next, as for the Shearing Machine, operational difficulties had occurred frequently after a few hundreds tons of spent fuel processing. This machine consists of quite complicated internal parts as shown in this viewgraph, and such operational difficulties were mainly cased by the wear and tear of moving internal parts, deposition of fuel powder, and sticking of fuel rods or tips. During the shut-down period, almost all internal parts, marked red in this viewgraph, were renewed remotely, with improvement as much as possible.

__________ (Slide #13 : パルスフィルタ)

The dissolver solution is clarified by the Pulsed Filter to remove insoluble fines by filtration. The filter element has to be washed periodically, and sooner or later, depending on the fuel burn-up, to be replaced. This maintenance work had affected not a little to the plant efficiency. Therefore the second pulsed filter was additionally installed in a high active cell with newly developed switching valves.

__________ (Slide # 14 : 90-1 実績)

After these improvements, the plant efficiency was expected to increase from current 58 % to 64 %, and annual reprocessing amount from about 70 tons to 90 tons. Last year, two reprocessing campaign were planed in TRP as before. First one was 90-1st

Campaign with scheduled amount of 65 tons based on 64 % efficiency. As shown in this viewgraph, 65.2 tons of spent fuel was successfully processed.

__________ (Slide #15 : 90-2 実績)

Also, in second one, 90-2nd Campaign, 33.9 tons of spent fuel was processed, which exceeded the scheduled amount of 30 tons. As a result, 99 tons of fuel was processed last year, and the first step was maintained for the 90 tons/year-basis operation.

__________ (Slide #16 : 世界の比較)

During the second campaign last year, the total amount of reprocessing in TRP exceeded 500 tons. As shown in this table, this amount is next to French-achievement in the world on oxide spent fuel reprocessing.

Now, about a future plan on TRP operation.

__________ (Slide #17 : もんじゅ写真)

The development of Fast Breeder Reactor is placed in the national project aiming at the future full-scale utilization of plutonium in terms of energy security in Japan and effective use of resources worldwide. In this context, PNC is now constructing the prototype FBR "Monju" as shown in this photograph. The construction of "Monju" is almost completed and the total functional test will be started soon. Reaching criticality is scheduled in October next year, and initial loading fuels are fabricated in PNC-Tokai Works.

TRP is supplying the plutonium for "Monju" fuel, in addition to for existing experimental FBR "Joyo", prototype ATR "Fugen", and plutonium for thermal reactors, currently, and is expected to do so in future.

Therefore, TRP should continue reprocessing as much as possible for future several years. However, after that, TRP is planned to move to more R&D-oriented operation.

The Atomic Energy Commission in Japan prepares Long-term Program for Development and Utilization of Nuclear Energy, every five years. In the current version, TRP is recommended to shift the main point of the activities toward the R&D field, after the commissioning of JNFS reprocessing plant.

__________ (Slide #18 : R＆D一覧)

The major R&Ds in TRP so far were primarily relating to maintain the steady plant operation. Based on the recent operational results, the purpose of R&D activity shall be move to more advanced and sophisticated areas compared before. The major items of interest are summarized in this viewgraph.

The first one is the advanced techniques for reprocessing of higher burn-up fuels. The burn-up specification of TRP is daily average of 28,000 MWD/ton and maximum 35,000 MWD/ton of fuel assembly-basis.

Recently, the project to increase the LWR fuel burn-up is going on in Japan above 50,000 MWD/ton, and also the demonstration program for plutonium recycling as MOx fuel in LWR core is proceeding smoothly. The study is already started to reprocess these special fuels in TRP by current purex process.

The second one is the remote handling techniques. More advanced techniques are pursued through individual developments such as Dissolver-Repairing-Machine, In-service Inspection-Equipment, Dissolver-Dismantling-Technique, and so on.

Strengthening the Engineering Data-base using a computer system and computer-aided Operation-Support-System such as the Process-Simulator, Instruction System have been continued to develop, however, these development should be done more extensively in future as the comprehensive compilation of a lot of experience and knowledge, and as the foundation of various R&D activities in future.

__________ (Slide #19 : HE 施設)

As I mentioned before, there still remains many problems in the head-end process, which means further developments on reprocessing will be mainly concerned to head-end. We are planning to have a new Head-end Process to be connected to existing Extraction Cycle, as shown in this viewgraph, for future extensive R&Ds.

__________ (Slide #20 : RETF概念図)

In addition, one of the important role of TRP in near future is to support the RETF, Recycling Equipment Test Facility, which will be used for development of FBR fuel reprocessing technology. This facility will be constructed adjacent to TRP, and the active products and waste produced from this facility will be treated in TRP, connecting the both facilities with piping.

__________ (Slide #21 : 長期計画)

Okay, my last viewgaraph shows the long-term schedule of TRP operation.

The TRP will continue about 90 ton/year-basis operation for future several years in order to supply the reprocessing for domestic utilities and to supply plutonium for development FBR, ATR, and so on. Scheduled shut-down periods, similar to previous one, but maybe shorter, will be considered every 4 to 5 years.

The RETF will start hot operatin in 1997 for the development of FBR fuel reprocessing.

The additional Head-end Facility to TRP is planned to start around 2000.

The JNFS commercial reprocessing plant is scheduled to start in the end of this century.

Therefore, the turning point of TRP will be around 2000, as a new century, and after that, more R&D activities will be extended in TRP, in closer connection with FBR fuel reprocessing, in order to contribute for establishing the plutonium utilization structure in

Japan.

Thank you for your attention.

Slide #1 : タイトル

The Operational Experience at Tokai Reprocessing Plant

O. YAMAMURA

Tokai Reprocessing Plant

Tokai Works

Power Reactor and Nuclear Fuel Development Corp.

Slide #2 : ＴＲＰ年表

Chronology of Tokai Reprocessing Plant

1956 Sep. AEC Decision on Reprocessing in Japan

1963 Oct. Contract with NCP, UK for Preliminary Design

1965 Dec. Contract with SGN, France for Detailed Design

1968 Aug. Start Licensing

1971 Jun. Start Construction

1974 Oct. Complete Construction and Blank Test

1974 Nov. Start Chemical Test

1975 Sep. Start Uranium Test

1977 Mar. Complete Uranium Test

1977 Jun. Japan-USA Joint Determination

1977 Jul. Receive Spent Fuel

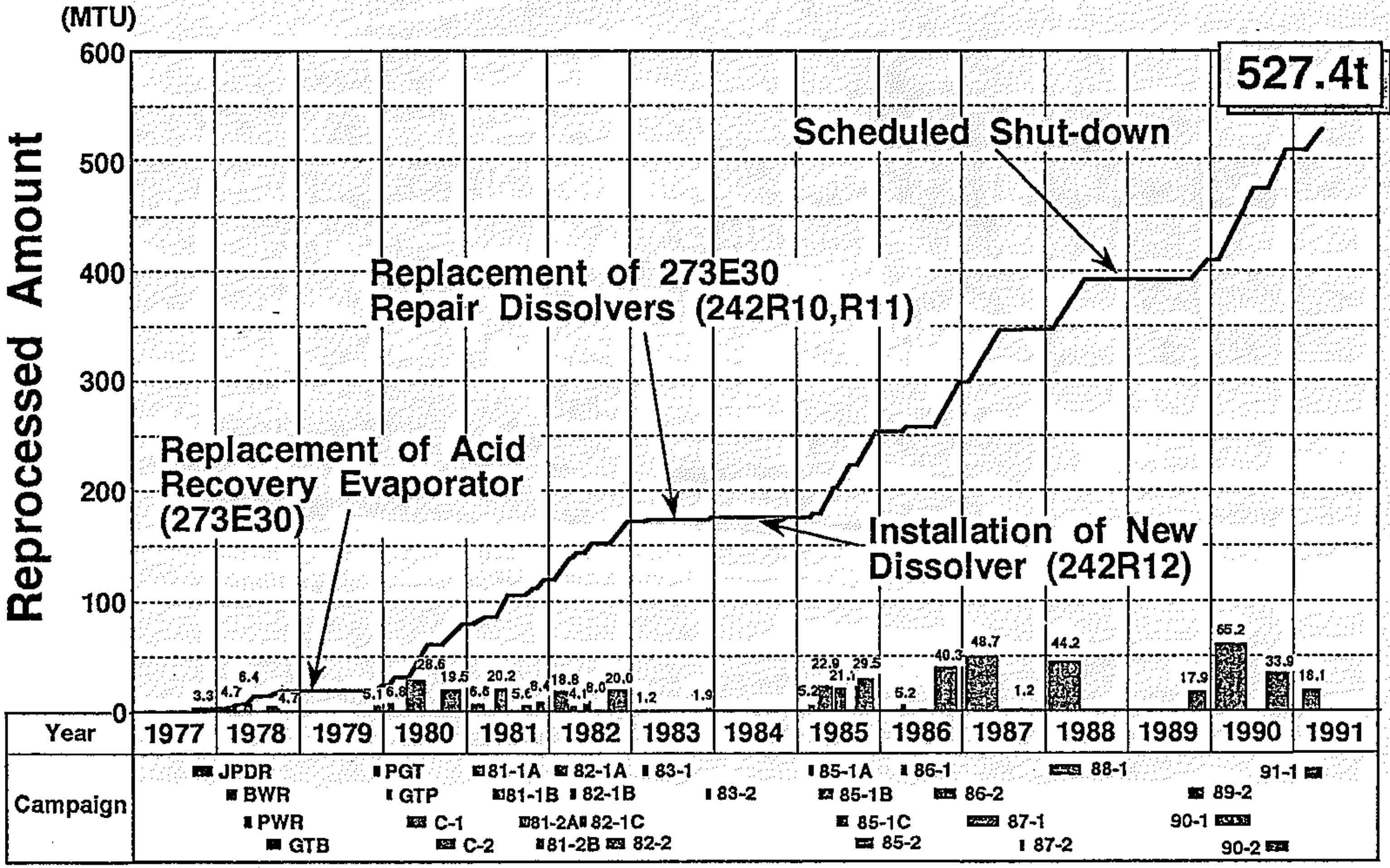
1977 Sep. Start Hot Test

1980 Apr. Start Pre-Commissioning Test

1981 Jan. Start Regular Operation

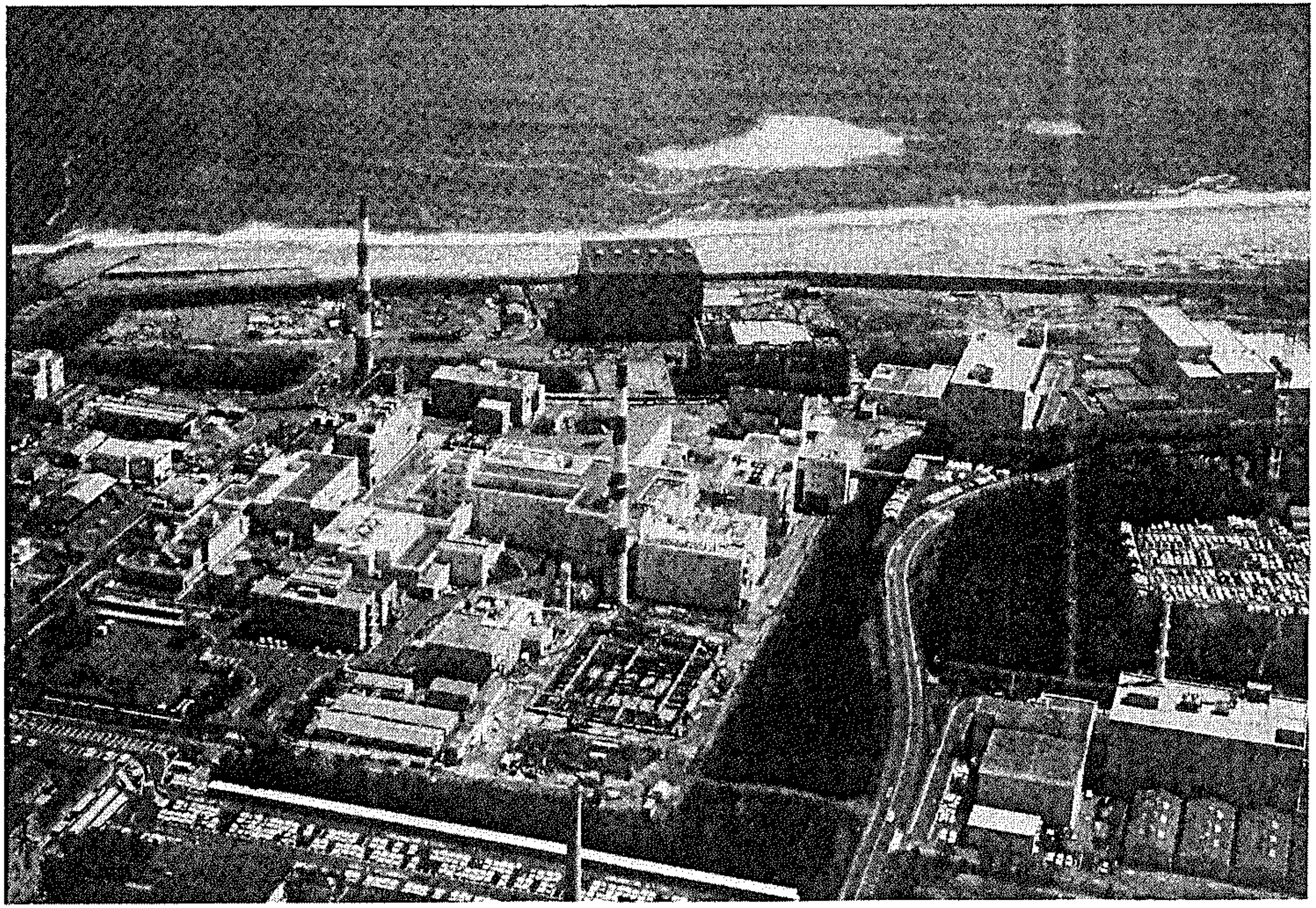
1990 Nov. Reprocessed Amount of 500 ton over

Slide #3： 処理グラフ



Operation History of TRP

Slide #4 :　ＴＲＰ写真



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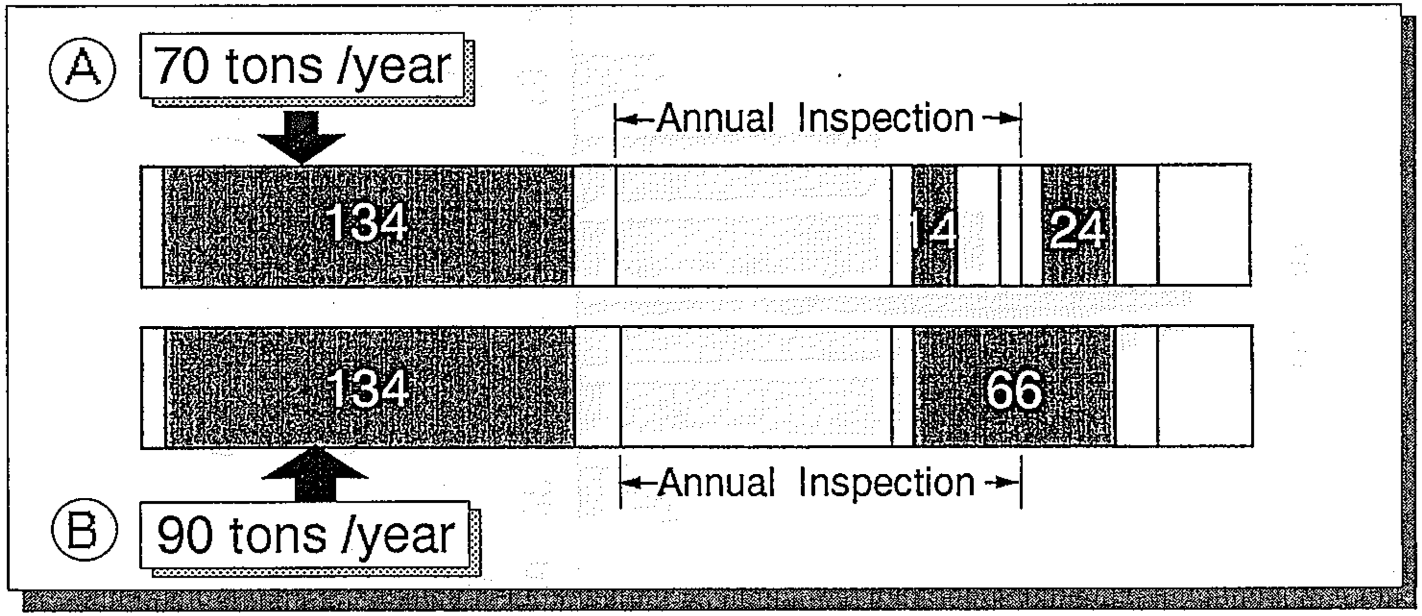
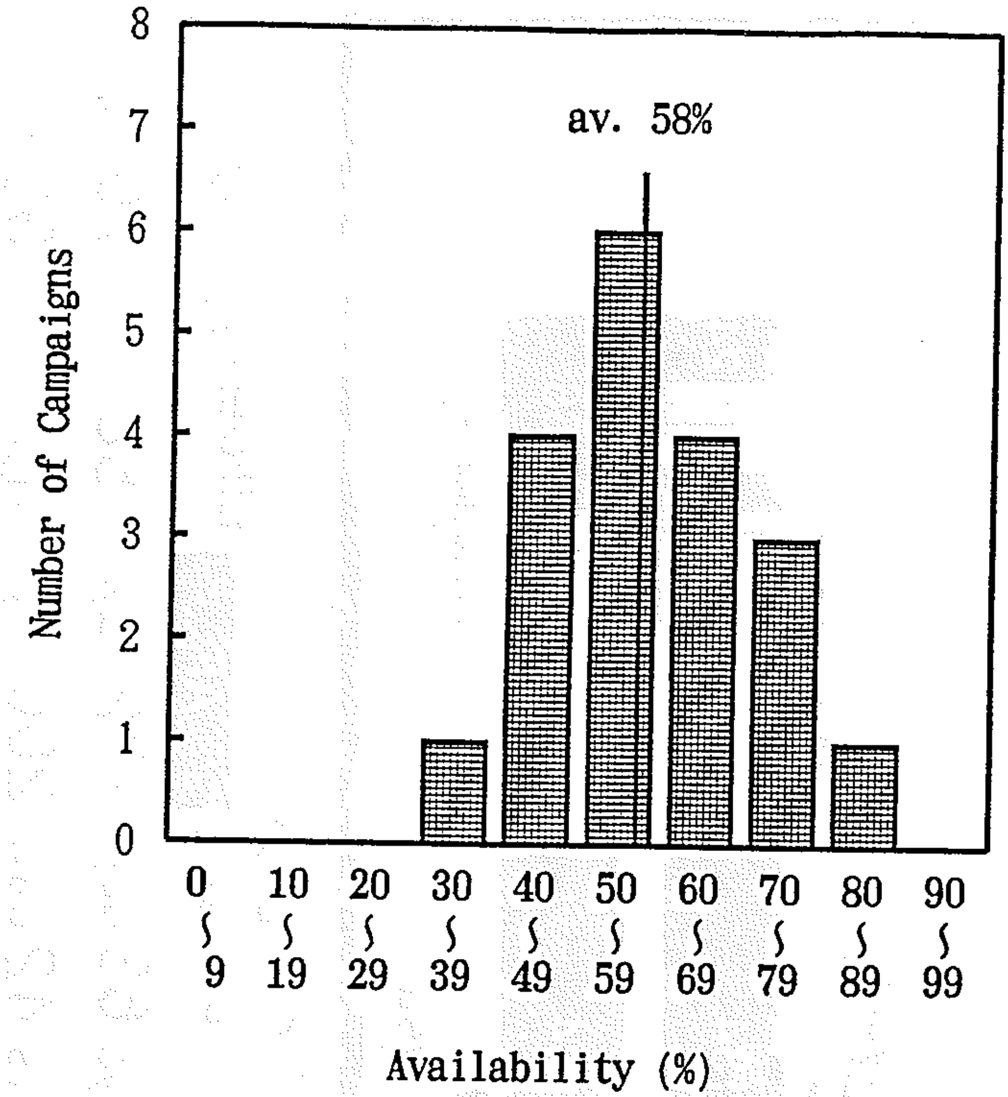
Slide #5： 年間運転モード



	Operation			Efficiency	/year
	I.C	Preparation	AF		
A	130 days	63 days	172 days	58 %	70 tons
B	123 days	42 days	200 days	64 %	90 tons

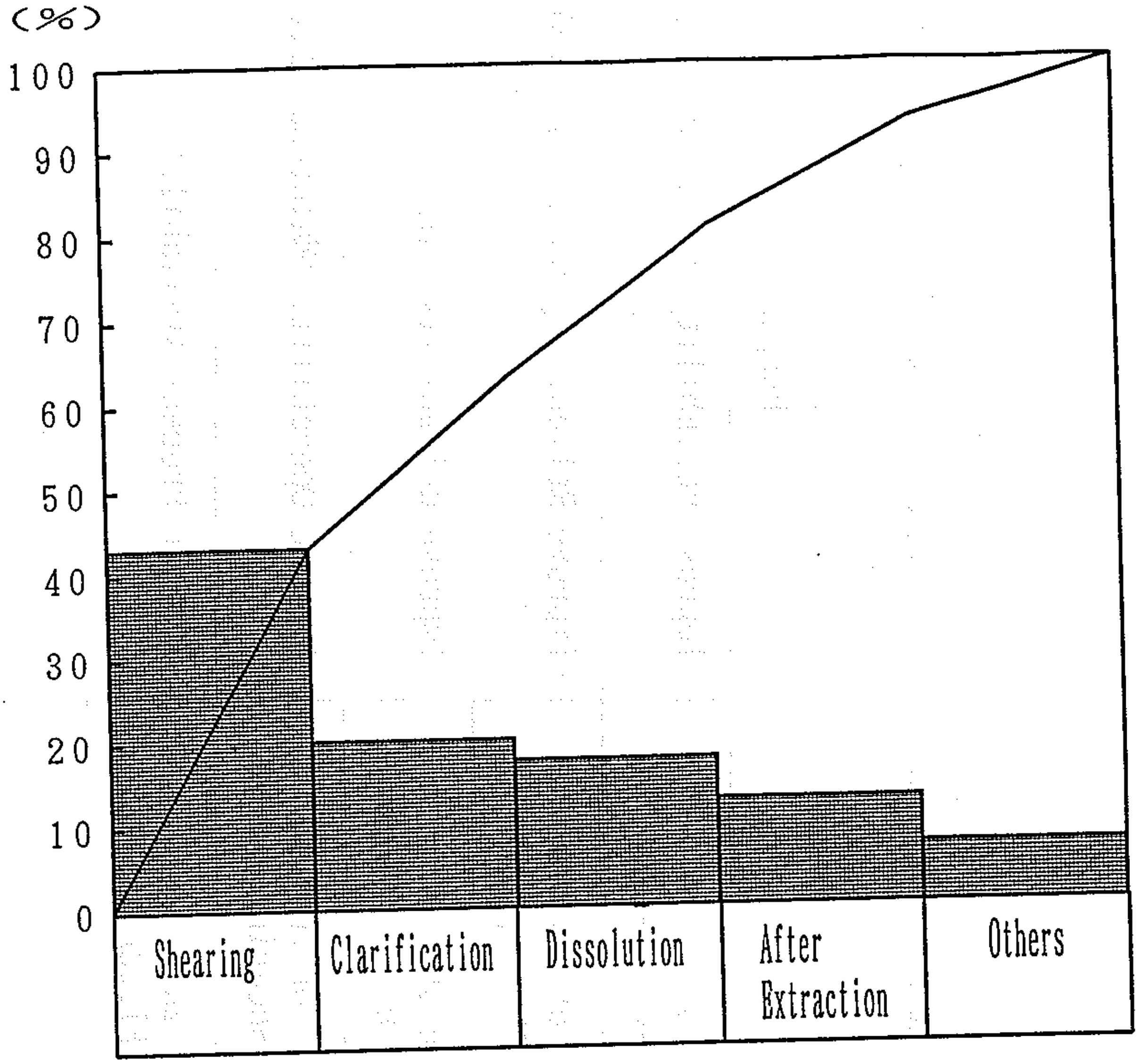
Annual Operarion Mode

Slide #6 : 稼働率ヒストグラム



Distribution of Availability before 1988

Slide #7： 不調原因プロセス



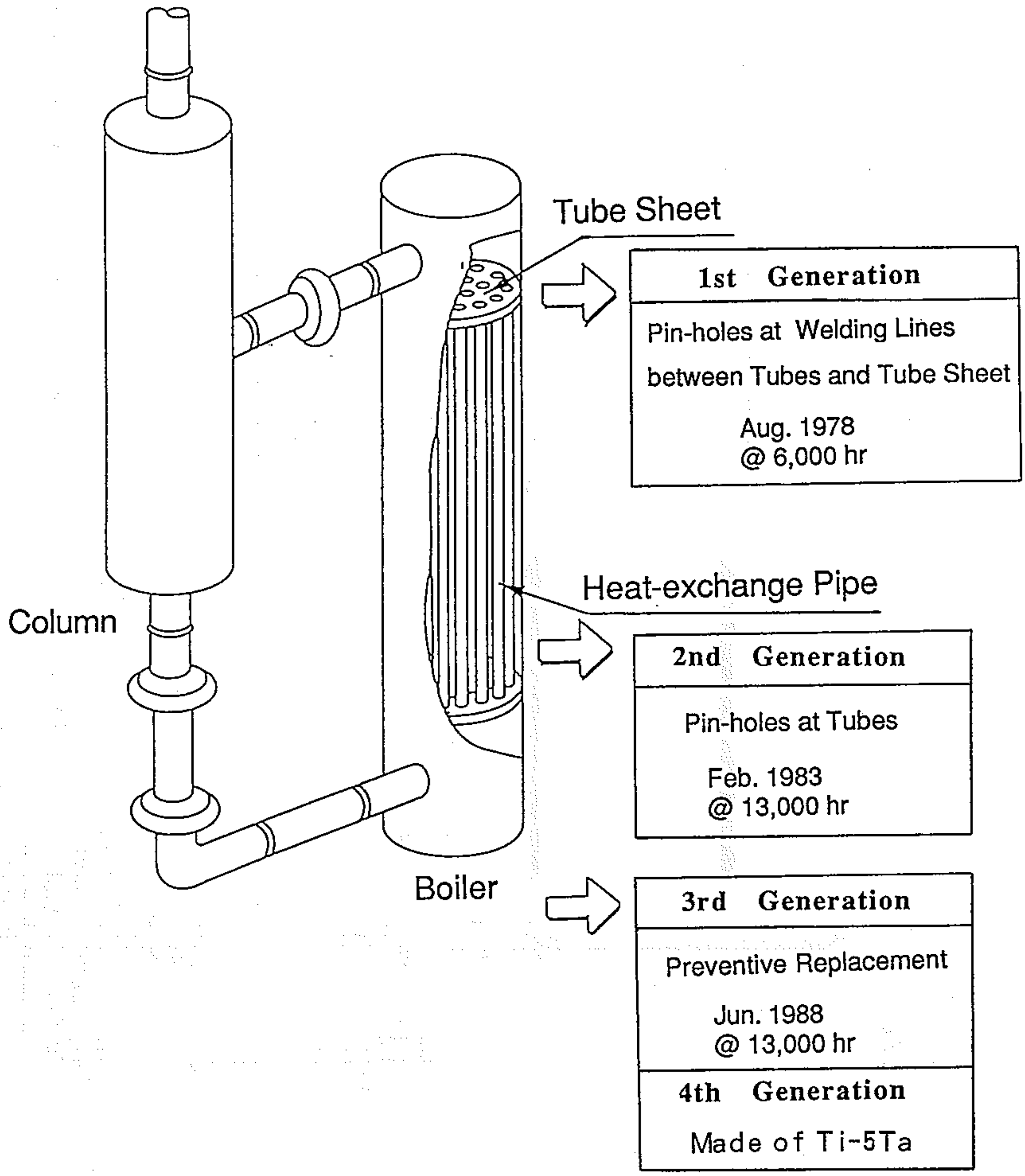
Failures Caused Interruption
of Continuous operation

Slide #8 : 五大工事表

Major Maintenance Work during Scheduled Shut-down Period

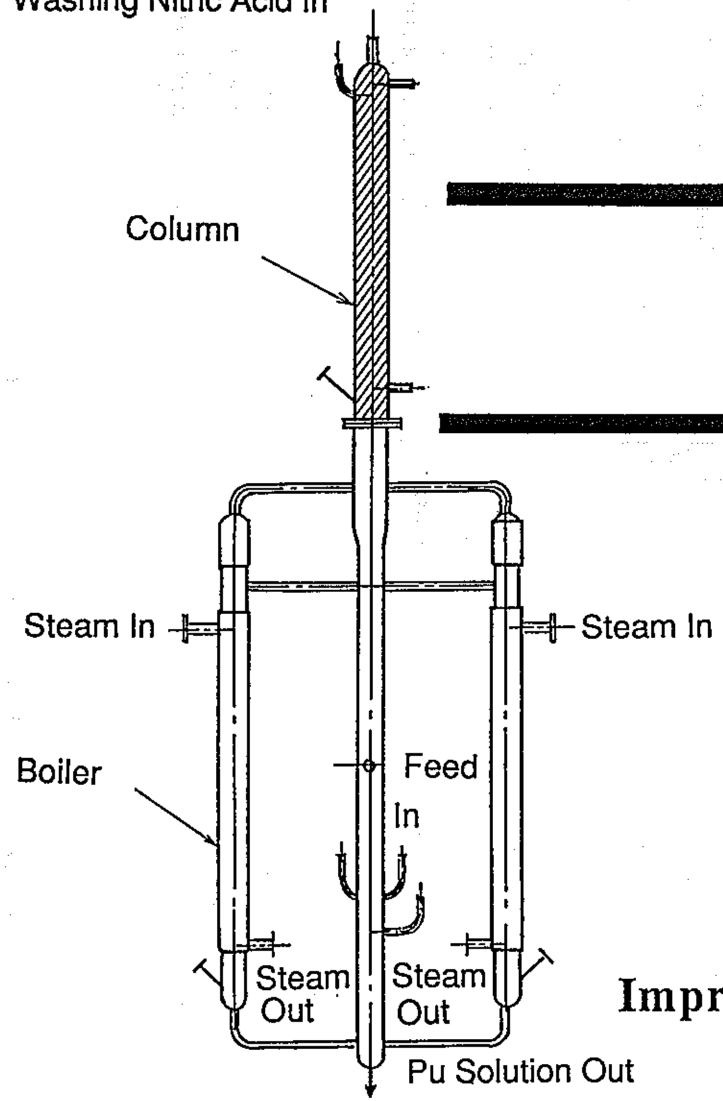
	Item	Purpose
Long-Term Viewpoint	Replacement of Acid Recovery Evaporator	-Improve Reliability by use of Ti-5Ta
	Replacement of Tower of Pu Solution Evaporator	-Improve Reliability by use of Ti-5Ta
	Modification of Acid Recovery Distillator	-Improve Reliability/Maintenability
Short-Term Viewpoint	Modification of Internal Parts of Shearing System	-Improve Operability/Maintenability
	Addition of 2nd Pulsed Filter	-Improve Process Availability

Slide 9： 酸回収蒸発缶



Acid Recovery Evaporator

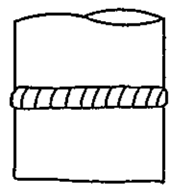
Slide #10：　プル蒸発缶



Material Improvement

to Ti-5Ta

Flange Connection ➡ Welding



Improvement of Pu Solution Evaporator

Slide #11： 酸回収精留塔

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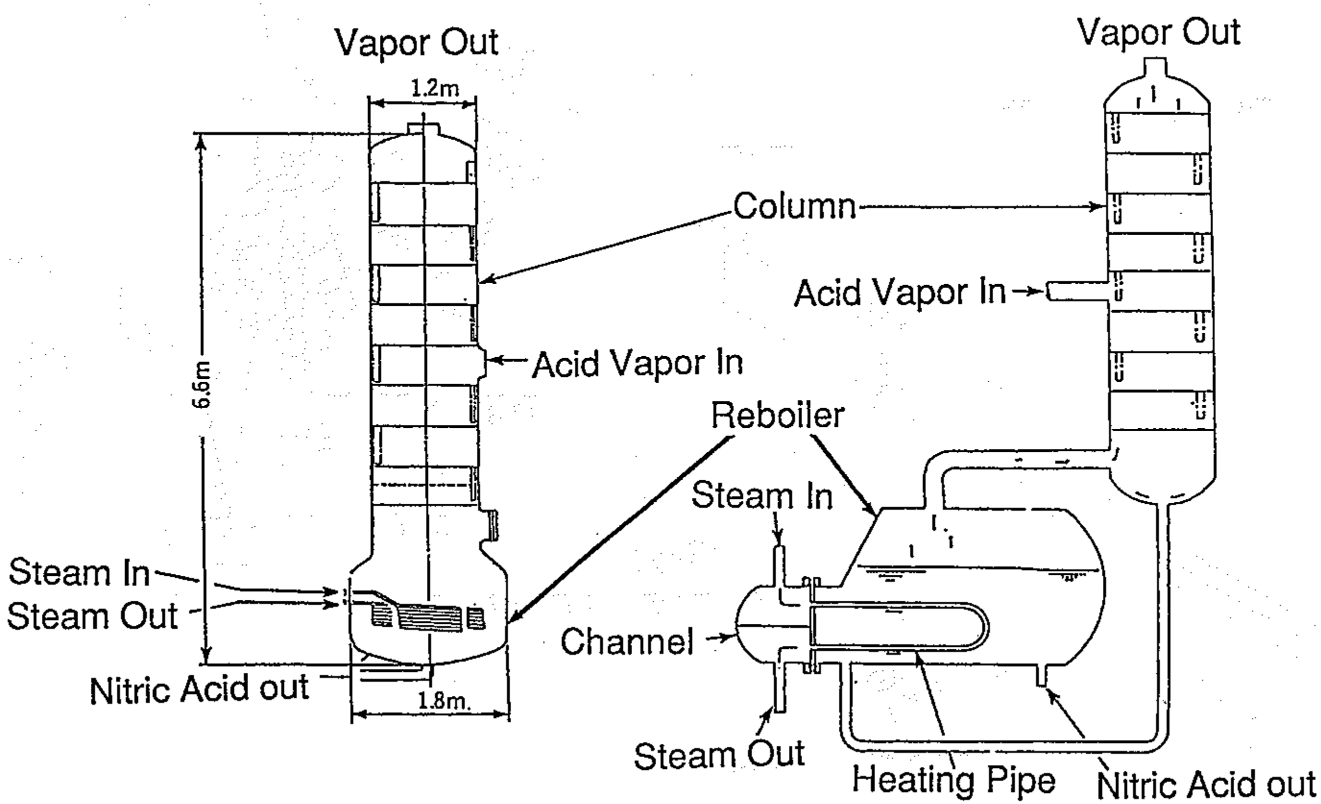
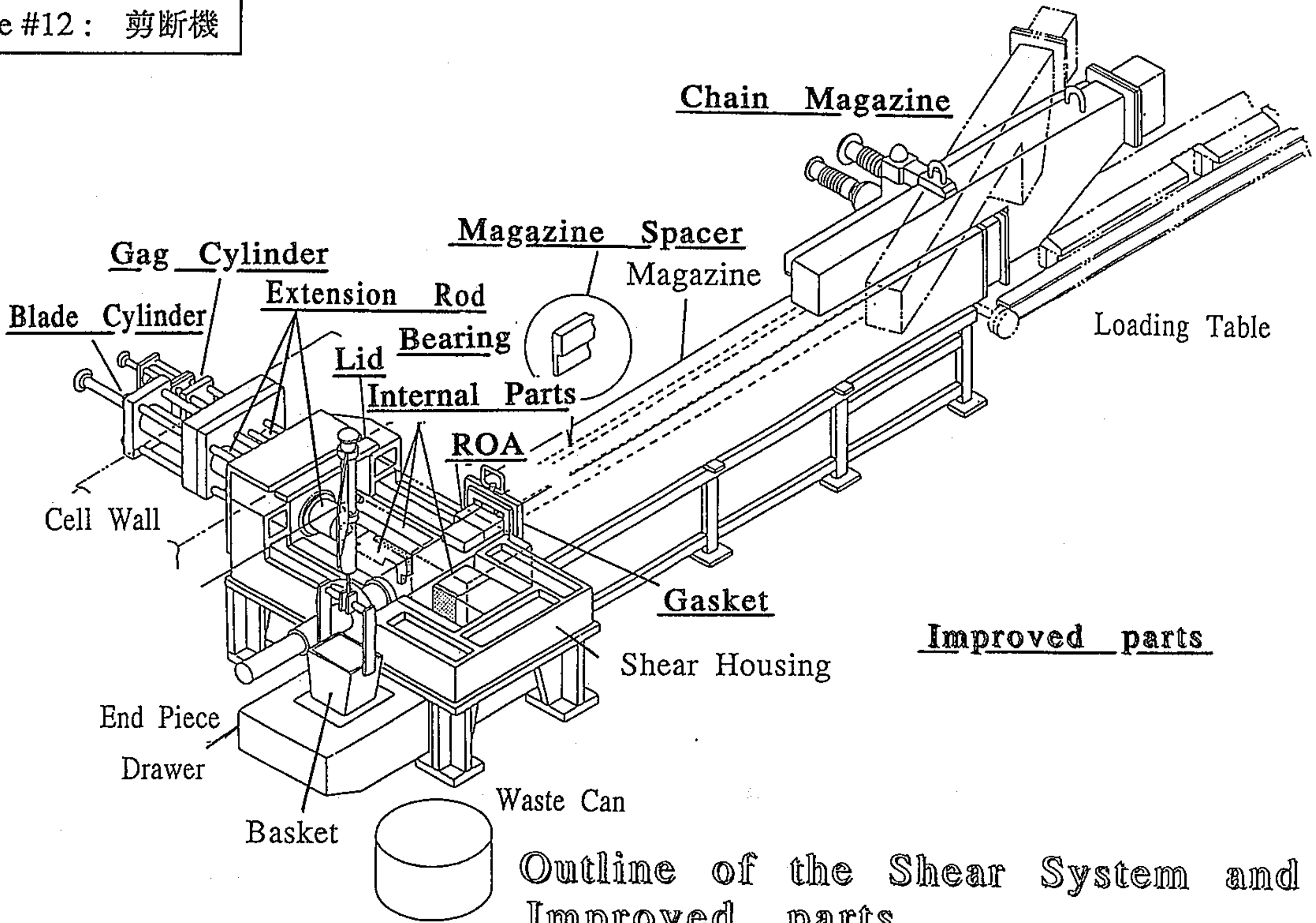
Modification of Acid Recovery Distillator



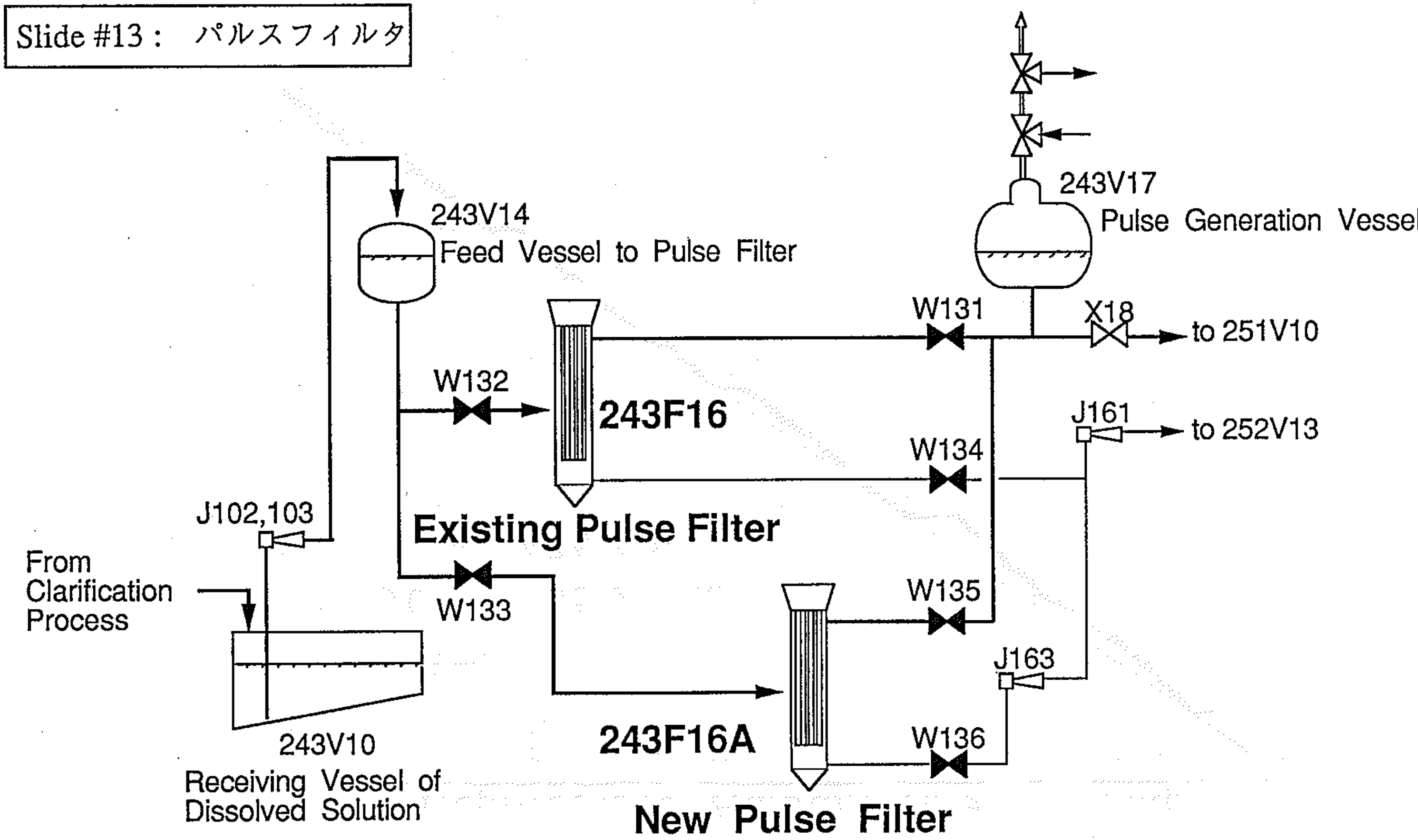
[BEFORE Modification]　　[AFTER Modification]

Slide #12： 剪断機



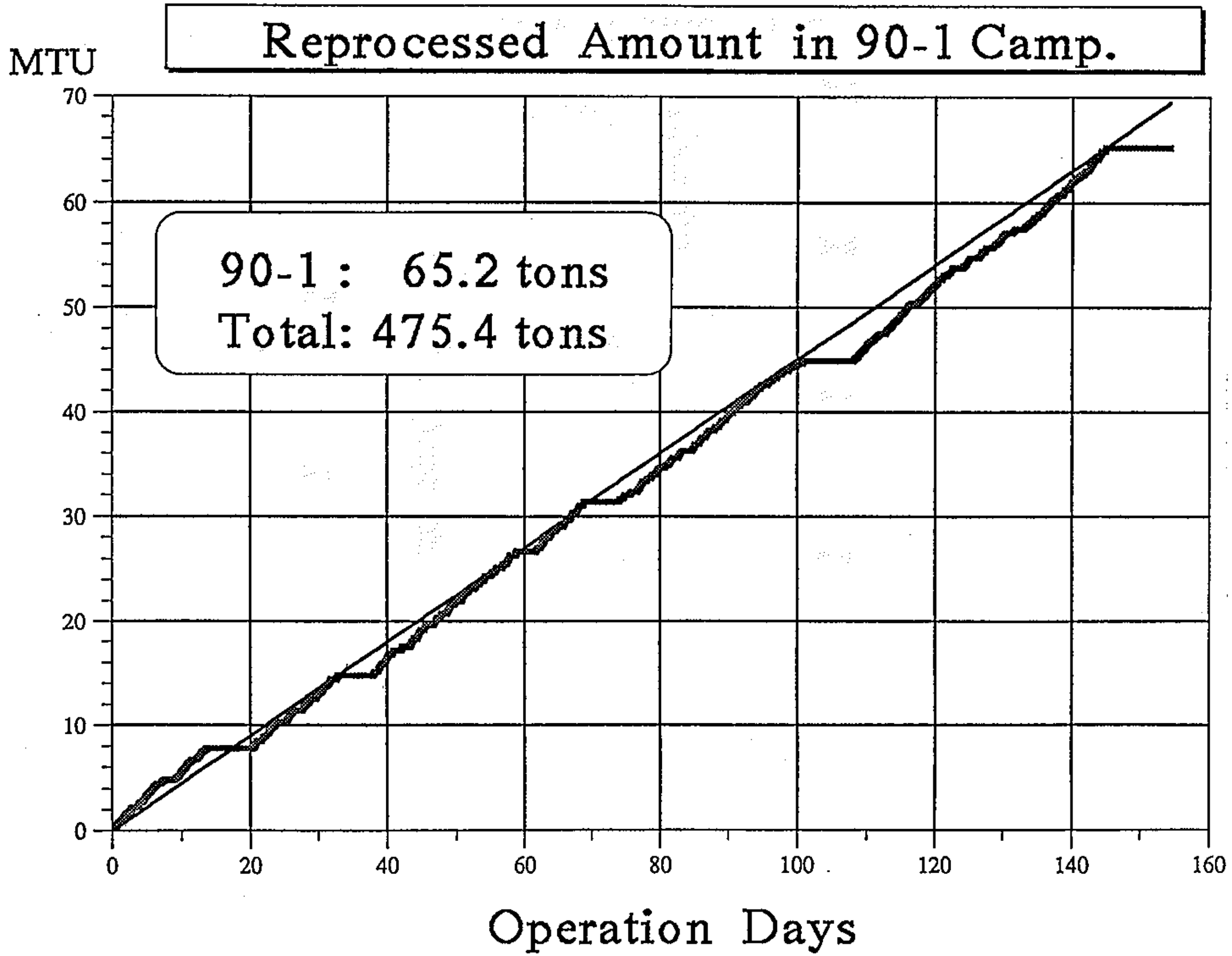
Outline of the Shear System and Improved parts

Slide #13： パルスフィルタ

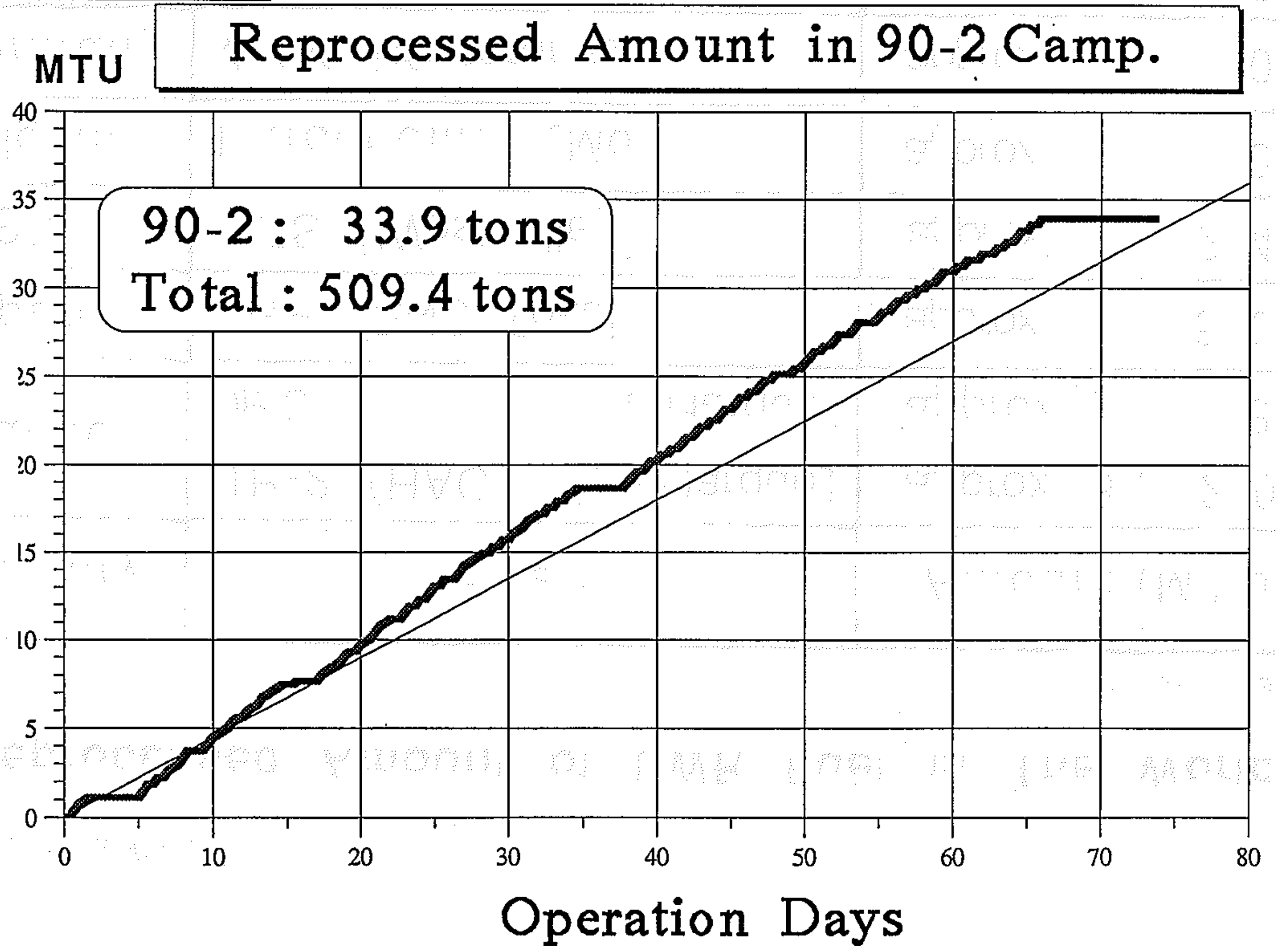


Flow Diagram of Clarification Process

Slide # 14 : 90-1 実績



Slide #15 : 90-2 実績



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Slide #16： 世界の比較

Reprocessed Amount of LWR Fuel in The World

<Oct. 1990>

Country	Plant	Amount (MTU)
France	UP-2 (HAO) [La Hargue] UP-3 [La Hargue]	approx. 3, 200 approx. 130
Japan	TRP [PNC Tokai]	approx. 500
USA	NFS [Westvalley]	approx. 245
Belgium	Eurochemic [Mol]	approx. 100
Germany	WAK [Karlsruhe]	approx. 100
UK	B-205 · HE Facility [Sellafiel	approx. 56

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Slide #17： もんじゅ写真

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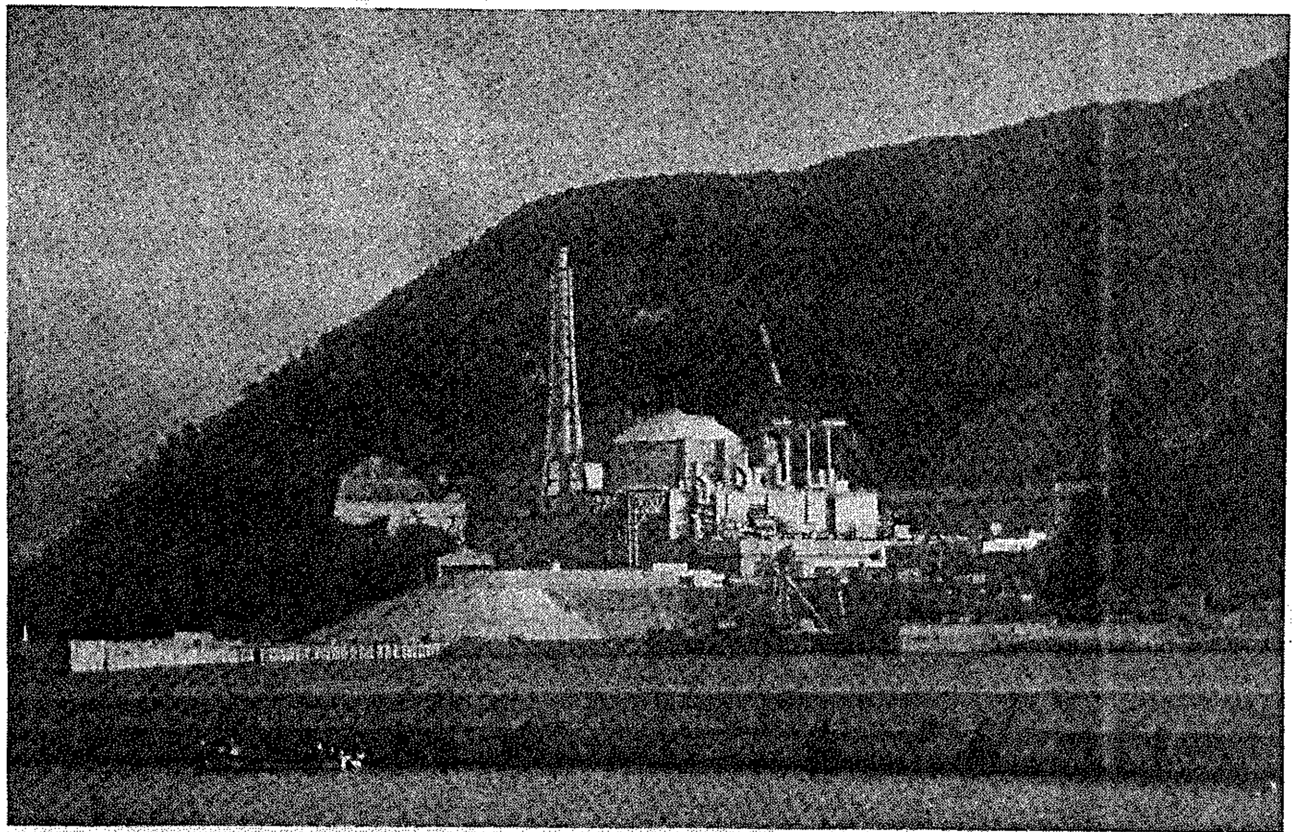

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Slide #18 : R&D一覧

Future R&D in TRP

(1) Advanced Technique for High Burn-up Fuel Reprocessing

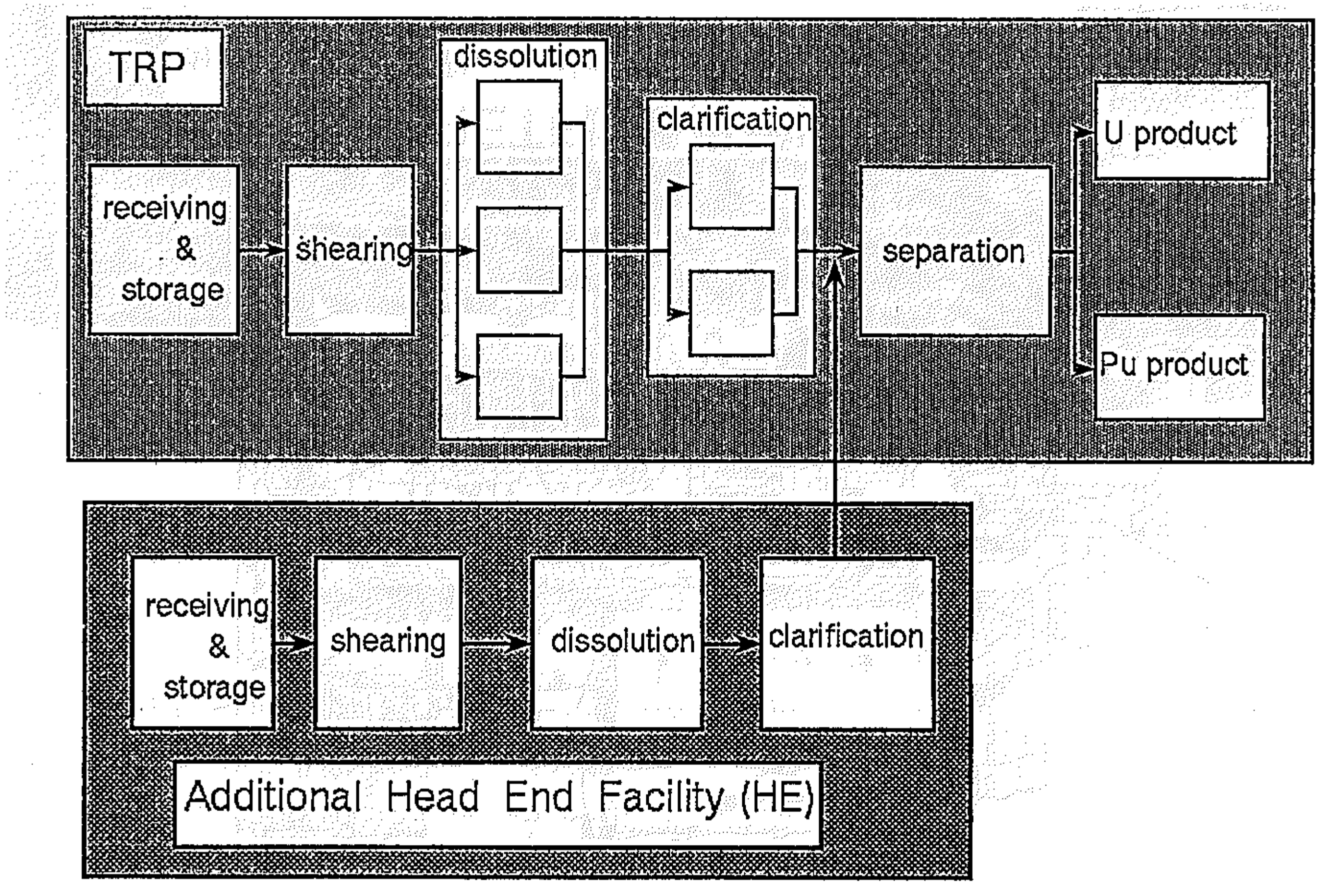
(2) Remote Handling Technique
- Advanced Repaire Equipment for Dissolvers
- In-service Inspection(ISI) Equipment
- Remote Dismantling Technique for Dissolvers

(3) Strengthening Engineering Data-base

(4) Operation Support System

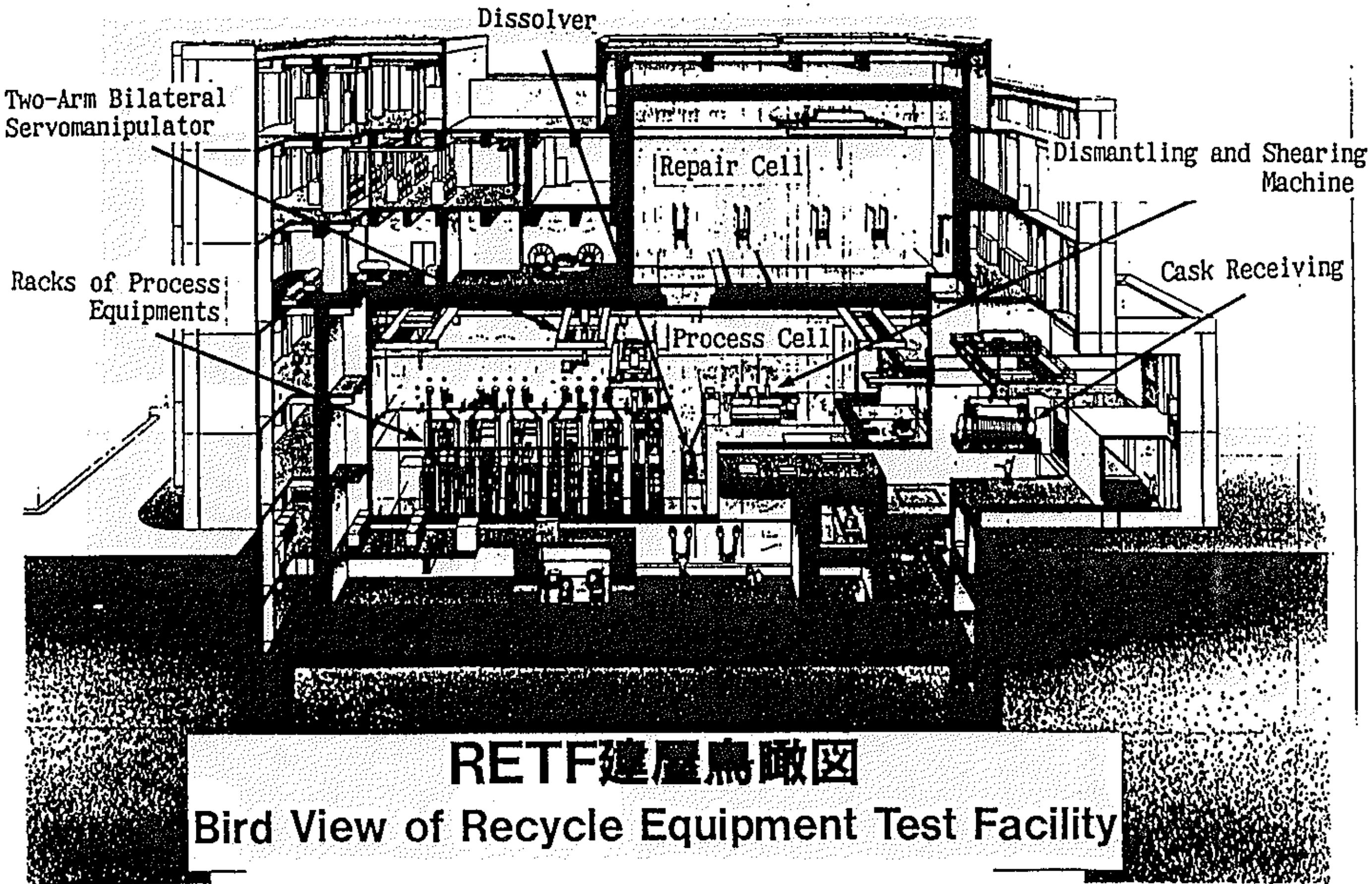
(5) Development Head-end Facility

Slide #19 : HE 施設



Conceptual Plan of Head End Project

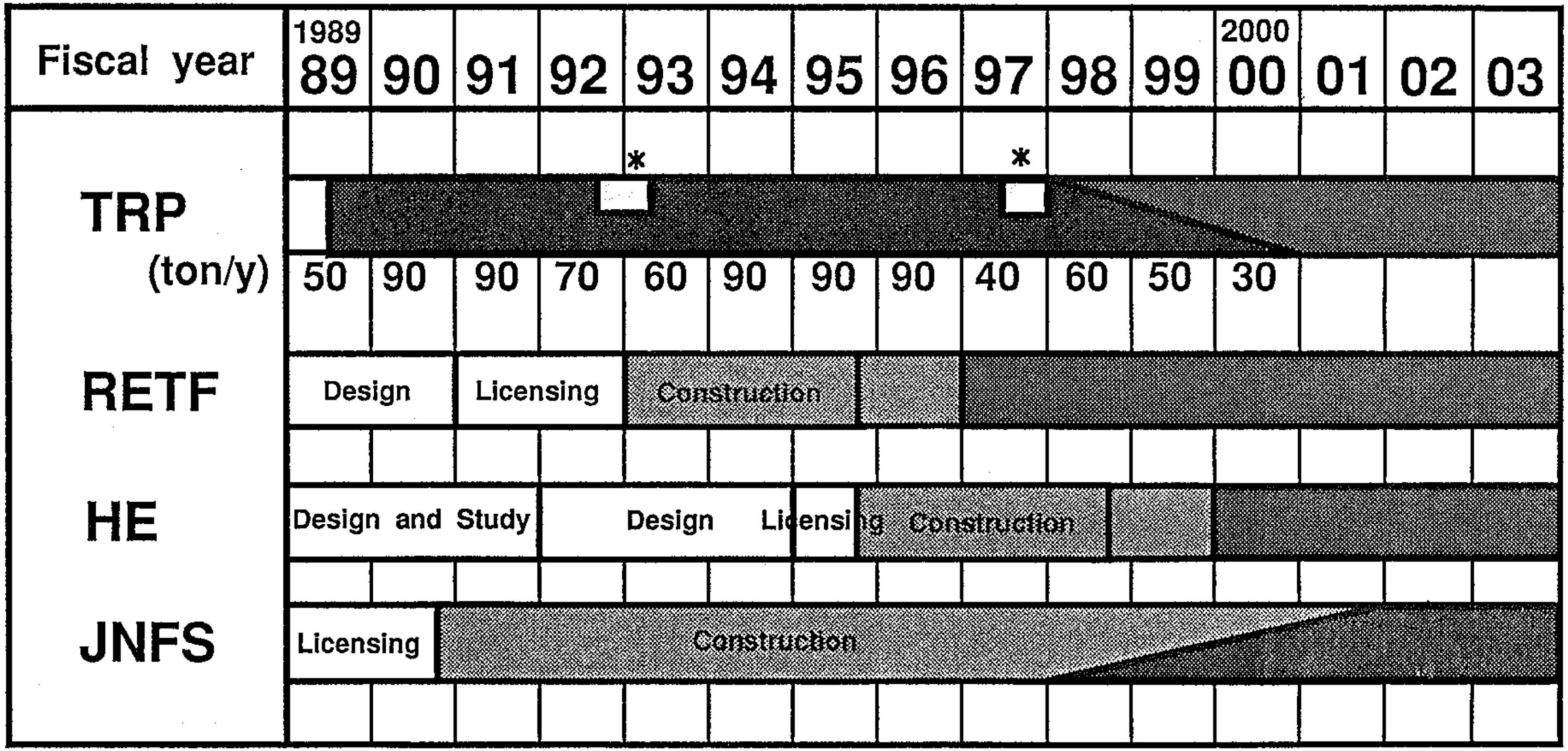
Slide #20： RETF概念図



（詳細設計（Ｉ）ベース）

Slide #21 : 長期計画

Long-term Schedule of TRP



* : Scheduled Shut-down

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