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Fabrication Drawings of Fuel Pins for FUJI Project among PSI, JNC and NRG

– Revised Version –

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ABSTRACT

Irradiation tests and post-irradiation examinations in the framework of JNC-PSI-NRG collaboration project will be performed in 2003~2005. Irradiation fuel pins will be fabricated by the middle of 2003. The fabrication procedure for irradiation fuel pins has been started in 2001. Several fabrication tests and qualification tests in JNC and PSI (Paul Scherrer Institute, Switzerland) have been performed before the fuel pin fabrication.

According to the design assignment between PSI and JNC in the frame of this project, PSI should make a specification document for the fuel pellet, the sphere-pac fuel particles, the vipac fuel particles, and the fuel pin. JNC should make a fabrication drawing for irradiation pins. JNC has been performed the fuel design in cooperation with PSI and NRG (Nuclear Research and Consultancy Group, Netherlands).

In this project, the pelletized fuel, the sphere-pac fuel, and the vipac fuel will be simultaneously irradiated on HFR (High Flux Reactor, Netherlands). This fabrication drawing has been made under the design assignment with PSI, and consists of the drawing of MOX pellet, thermal insulator pellet, pin components, fuel segments, and the constructed pin.

The fabrication drawings were approved in October 2001, but after that, the optimization of specifications has been discussed and agreed among all partners. In this report, the revised fabrication drawings will be shown.

Based on the commission of Plutonium Fuel Technology Group, Advanced Fuel Recycle Technology Division, this design work has been performed in Fuel Design and Evaluation Group, Plutonium Fuel Fabrication Division, Plutonium Fuel Center.

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PSI-JNC-NRG 共同研究 FUJI プロジェクト 燃料要素製造図面 - 改定版 -

（共同研究報告書）

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要　旨

PSI-JNC-NRG 共同研究 FUJI プロジェクトとして照射試験及び照射後試験が西暦 2003～2005 年にかけて実施される予定である。本照射試験に供する照射燃料要素は西暦 2003 年中頃までに製造する必要があり、2001 年に一部開始した。さらに、照射燃料要素の製造に先立ち、いくつかの先行試験を JNC 及び PSI（Paul Scherrer Institute, スイス）で実施した。

本共同研究では、JNC と PSI の設計分担にしたがい、PSI は燃料ペレット、スフェアパック燃料粒子、バイパック燃料粒子及び燃料要素に対する製造仕様書を作成し、JNC は照射燃料要素に対する製造図面を作成することとなっている。また、JNC は PSI 及び NRG（Nuclear Research and Consultancy Group, オランダ）と協力して燃料設計を進めることとしている。

本共同研究においては、ペレット燃料、スフェアパック燃料及びバイパック燃料を HFR（High Flux Reactor、オランダ）で同時に照射する予定である。本製造図面は PSI との設計分担に基づき作成したものであり、MOX 燃料ペレット図、熱遮蔽ペレット図、燃料要素構成部品図、燃料セグメント図及び燃料要素組立図より成る。

製造図面は 2001 年 10 月に承認されたが、その後、燃料仕様の最適化について検討し、三者間で合意に至った。本報告書では、改定後の製造図面について示す。

なお、本設計作業は、環境保全・研究開発センター　先進部　プルトニウム燃料開発 Gr. の依頼に基づき、プルトニウム燃料センター　製造加工部　設計評価 Gr.にて実施した。

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CONTENT

1. Introduction

Irradiation tests and post-irradiation examinations in the framework of JNC-PSI-NRG collaboration will be performed in 2003~2005. Irradiation fuel pins should be fabricated by the middle of 2003. The fabrication procedure for irradiation fuel pins will be start in 2001. Several qualification tests in JNC and PSI have been performed before the fuel pin fabrication. In this project, the pellet fuel, the sphere-pac fuel, and the vipac fuel will be irradiated simultaneously.

According to the design assignment between PSI and JNC in the frame of this project, PSI should make a specification document for the fuel pellet, the sphere-pac fuel particles, the vipac fuel particles, and the fuel pin. JNC should make a fabrication drawing for irradiation pins. This fabrication drawing has been made under this assignment in cooperation with PSI and NRG, and will specify irradiation fuel pins, and consists of the drawing of MOX pellet, thermal insulator pellet, pin components, fuel segments, and the constructed pin.

In this paper, the revised fabrication drawings will be shown.

2. The Outline of Irradiation Tests

Irradiation tests in the framework of JNC-PSI-NRG collaboration will be performed by using a KAKADU facility on the HFR in Netherlands. The purpose of irradiation tests is to obtain data concerning a comparison of the irradiation behavior among the sphere-pac fuel (MOX, Np-MOX), the vipac fuel (MOX), and the pellet fuel (MOX).

The initial sintering test, the 1st restructuring test, the 2nd restructuring test, and the power-to-melt (PTM) test will be performed in this program. For each test, the following time versus power curves will be used:

- Initial sintering test : maximum power 550W/cm, duration 36 hours,
- 1st restructuring test : maximum power 550W/cm, duration 84 hours,
- 2nd restructuring test : maximum power 550Wcm, duration 132 hours,
- Power-to-melt test : maximum power 900W/cm, duration 85 hours.

The maximum burnup of irradiated fuel is planned less than 1,000MWd/t (the maximum EFPD is approx. 4 days for the 2nd restructuring test).

3. Pin Fabrication

Due to transportation from PSI to NRG after pin fabrication at PSI, the fuel pin for HFR irradiation test can be separated into two segments as the upper and lower segment. Two kinds of segment, such as MOX pellet fuel segment and MOX sphere-pac fuel segment, should be fabricated as the upper fuel segment. Four kinds of segment, such as MOX pellet fuel segment, MOX sphere-pac fuel segment, Np-MOX sphere-pac fuel segment, and MOX vipac fuel segment, should be done as the lower fuel segment. The pellet fuel, the sphere-pac fuel, the vipac fuel, and the particle retainer that is a component of the sphere-pac and vipac fuel segment should be fabricated at PSI. The other pin component should be fabricated by JNC and delivered from JNC to PSI. In these delivery components, the cladding and the connection endplug should be beforehand welded in JNC, and the cladding with connection endplug should be delivered to PSI. The kind of fuel segment used for each irradiation test is shown as the following table. Each fuel segment should be fabricated at PSI, and assembled into a fuel pin at NRG.

	KAKADU-Facility							
	Initial Sintering ≤ 550 W/cm		Restructuring (1) ≤ 550 W/cm		Restructuring (2) ≤ 550 W/cm (<1000MWd/t)		PTM < 900 W/cm	
Fuel type	MOX	MOX	MOX	MOX	MOX	MOX	MOX	MOX
Fuel form	Pellet	Sphere pac	Pellet	Sphere pac	Pellet	Sphere pac	Pellet	Sphere pac
Fuel density	95%T.D.	95%T.D.	95%T.D.	95%T.D.	95%T.D.	95%T.D.	95%T.D.	95%T.D.
Fuel column length	50mm	250mm	50mm	250mm	50mm	250mm	250mm	250mm
	Upper Fuel Segment							
	Lower Fuel Segment							
Fuel type	MOX	MOX	MOX	Np-MOX	MOX	MOX	MOX	Np-MOX
Fuel form	Sphere pac	Vipac	Sphere pac	Sphere pac	Sphere pac	Vipac	Pellet	Sphere pac
Fuel density	95%T.D.	95%T.D.	95%T.D.	95%T.D.	95%T.D.	95%T.D.	95%T.D.	95%T.D.
Fuel column length	250mm	250mm	250mm	250mm	250mm	250mm	250mm	250mm

4. The Method of Pin Fabrication

The pellet fuel segment should be fabricated as the upper and the lower segment. After loading a thermal insulator pellet (depleted UO_2) of 10mm height into a cladding with the lower or the upper connection endplug beforehand engraved the designated ID number for the upper or the lower pellet fuel segment, the MOX pellets should be loaded so that the MOX fuel stack length would be 50mm for the initial sintering and restructuring test segment, and 250mm for the PTM test segment. Then, a thermal insulator pellet of 10mm height, a plenum spring, and five plenum sleeves for the initial sintering and restructuring test segment or one plenum sleeve for the PTM test segment should be mounted in order. After mounting above all components, the upper or the lower closure endplug beforehand engraved the designated pin ID number should be welded in He atmosphere, and the segment should be sealed up.

The sphere-pac fuel segment should be fabricated as both the upper segment filled with MOX sphere-pac fuel and the lower segment filled with MOX or Np-MOX sphere-pac fuel. For the upper segment, after mounting a fuel seal disc (FSD) made of tungsten into a cladding with the lower connection endplug, which is beforehand engraved the designated ID number for the upper sphere-pac fuel segment, the thermal insulator (natural UO_2) spheres should be filled so that the height would be 10mm. Then, the MOX spheres should be mounted so that the MOX fuel stack length would be 250mm. After that, the thermal insulator spheres should be filled so that the height would be 10mm, and the fuel stack should be fixed by a particle retainer. Then, after a special plenum sleeve adjusted to the suitable length is mounted, the upper closure endplug beforehand engraved the designated pin ID number should be welded in He atmosphere, and the upper segment should be sealed up. For the lower segment, after mounting a fuel seal disc (FSD) made of tungsten into a cladding with the upper connection endplug, which is beforehand engraved the designated ID number for the lower sphere-pac fuel segment, the thermal insulator (natural UO_2) spheres should be filled so that the height would be 10mm. Then, the MOX or Np-MOX spheres should be mounted so that the fuel stack length would be 250mm. After that, the thermal insulator spheres should be filled so that the height would be 10mm, and the fuel stack should be fixed by a particle retainer. Then, after a special plenum sleeve adjusted to the suitable length is mounted, the lower closure endplug should be welded in He atmosphere, and the lower segment should be sealed up.

The vipac-pac fuel segment should be fabricated as the only lower segment. After mounting an FSD made of tungsten into a cladding with the upper connection endplug , which is beforehand engraved the designated ID number for the lower vipac fuel segment, the thermal insulator (natural UO_2) spheres should be filled so that the height would be 10mm. Then, after FSD should be mounted again in order to prevent the intermixing during the filling, the MOX vipac particles should be mounted so that the fuel stack length would be 250mm. After that, the thermal insulator spheres should be filled so that the height would be 10mm, and the fuel stack should be fixed by a particle retainer. Then, after a special plenum sleeve adjusted to the suitable length is mounted, the lower closure endplug should be welded in He atmosphere, and the lower segment should be sealed up.

After the overall bowing of pin connected two segments fabricated in above way should be inspected at PSI, they should be enclosed in the transport container and transported from PSI to NRG. Then, according to the designated combination, the upper and lower segment should be connected and fixed by the TIG spot welding after putting a spacer between two segments.

According to the designated combination, each two fuel pins should be loaded into the sample holder designed by NRG, and used for the irradiation test.

5. Welding Qualification Tests

The welding procedure for the connection endplug and the closure endplug has to be assured by the qualification test. In the qualification test, the nondestructive examination, such as the visual examination and the X-ray examination, and the destructive examination, such as the ceramographic examination, the tensile examination and the inner pressure burst examination, have to be performed for welding specimens. Ten welding specimens should be made in the qualification test. Three welding specimens should be used for the ceramographic examination, three welding specimens should be used for the tensile examination, three welding specimens should be used for the inner pressure burst examination, and one welding specimen should be used as a standard sample in the visual inspection for the endplug welding. The tensile examination and the inner pressure burst examination will be performed at JNC. The tensile strength at weld zone should be more than 4,903N in the qualification test. The weld zone should burst at more than 74MPa inner pressure at the room temperature in the qualification test. The destructive examination does not have to be performed for the fabricated component. The welding depth should be more than cladding thickness. There should be no remarkable coloring and under cut on the weld zone. The outer diameter at the welded bead between the endplug and the cladding should not exceed 7.65mm. There should be no crack, inclusion, pinhole, and blowhole exceeding 0.2mm at the weld zone.

6. Fabrication Drawings

Fabrication drawings of fuel pins for HFR irradiation tests are shown in Attachment A. The detailed design will be mentioned as follows.

(1) FUEL RODS

The revised drawing of fuel rods is shown in **SPFH0-2PM-02003**. Taking account of the restriction on the transport container, the fuel rod consists of the upper fuel segment of 455mm length and the lower fuel segment of 459.9mm length. After putting a spacer between the upper and lower fuel segment, two fuel segments should be connected by the connection endplug with a screw, and fixed by the TIG spot welding so as not to rotate after connection. The overall length of the fuel rod has been specified as 910±2mm. Taking account of the restriction on the sample holder, the overall pin bowing of the fuel pin consisting of the assembled fuel segments should be less than 1.5mm (aimed at less than 1.0mm). The upper endplug should be engraved the designated pin ID number. The upper and lower connection endplug should be engraved the designated segment ID number for the lower and upper fuel segment, respectively. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(2) PELLET FUEL SEGMENT (UPPER)

The revised drawing of the upper pellet fuel segment is shown in **SPFH0-2PM-02004**. The upper pellet fuel segment should have a lower connection endplug with a female screw, which is engraved the designated segment ID number, and an upper endplug engraved the designated pin ID number. Taking account of the restriction on the transport container, the overall length of an upper pellet fuel segment is should be 455mm. In consideration of the dimension of the fabricated cladding for delivery, the cladding inner and outer diameter has been specified as 6.70±0.03mm and 7.50±0.03mm, respectively (already fabricated). The fuel stack length should be 50mm for the initial sintering and restructuring test segment, and 250mm for the PTM test segment. A thermal insulator pellet specified as 10±1mm height is arranged above and below the MOX fuel stack. Due to possibility to construct the fuel stack without using any adjusting pellet, the tolerance of the fuel stack length and the length of a pellet has been specified as ±5mm and 10±1mm, respectively. Corresponding to the fuel stack length for each irradiation test, the upper pellet fuel segment for the initial sintering and the restructuring test has five plenum sleeves of a total length of 250mm, and one for the PTM test does a plenum sleeve of 50mm length. A plenum spring is arranged between the plenum sleeve and the thermal insulator pellet. In consideration of transporting from Switzerland to Netherlands, the free length and the length in common use has been specified as 100±2mm and 80±8mm, respectively, from a viewpoint of ensuring the fixation of the fuel stack under the loading force due to acceleration of 6G. From a result of the plenum design, the overall cladding length has been specified as 410±0.5mm. The welding procedure for the upper endplug has to be assured by the qualification test (see section 5). The welding depth should be more than cladding thickness. The outer diameter at the welded bead between the upper endplug and the cladding should not exceed 7.65mm. The loose contamination on the surface should be less than $0.04Bq/cm^2$. He gas of >95% purity should be filled in the fuel segment, and the rest should be nitrogen only. He leak rate should not exceed $3x10^{-7}mbar \cdot l/sec$ ($3x10^{-9}Pa \cdot m^3/sec$) in the He leak test. There should be no remarkable coloring and under-cut on the weld zone. There should be no crack, inclusion, pinhole, and blowhole exceeding 0.2mm at the weld zone. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(3) SPHERE-PAC FUEL SEGMENT (UPPER)

The revised drawing of the upper sphere-pac fuel segment is shown in **SPFH0-2PM-02005**. The upper segment of the sphere-pac fuel should have a lower connection endplug with a female screw, which is engraved the designated segment ID number, and an upper endplug engraved the designated pin ID number. Taking account of the restriction on the transport container, the overall length of an upper segment of the sphere-pac fuel should be 455mm. In consideration of the dimension of the fabricated cladding for delivery, the cladding inner and outer diameter has been specified as 6.70±0.03mm and 7.50±0.03mm, respectively (already fabricated). In order to prevent broken particles going into a narrow gap between the lower connection endplug and the cladding, a fuel seal disc (FSD) made of tungsten is arranged between the lower connection endplug and the region of thermal insulator spheres. The fuel stack length has been specified as 250±5mm, similar to the pellet fuel segment for PTM test. The region of thermal insulator spheres specified as 10±1mm length is arranged above and below the MOX spheres fuel stack. In order to fix the fuel stack, a particle retainer is arranged at the end of the region of spheres. The length of a special plenum sleeve has been specified as 118±8mm so that the cladding length should be the same as the pellet fuel segment. The overall cladding length has been specified as 410±0.5mm, similar to the pellet fuel segment. The welding procedure for the upper endplug has to be assured by the qualification test (see section 5). The welding depth should be more than cladding thickness. The outer diameter at the welded bead between the upper endplug and the cladding should not exceed 7.65mm. The loose contamination on the surface should be less than 0.04Bq/cm^2. He gas of >95% purity should be filled in the fuel segment, and the rest should be nitrogen only. He leak rate should not exceed 3x10^{-7}mbar·l/sec (3x10^{-9}Pa·m^3/sec) in the He leak test. There should be no remarkable coloring and under-cut on the weld zone. There should be no crack, inclusion, pinhole, and blowhole exceeding 0.2mm at the weld zone. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(4) PELLET FUEL SEGMENT (LOWER)

The revised drawing of the lower pellet fuel segment is shown in **SPFH0-2PM-02006**. The lower pellet fuel segment should have a upper connection endplug with a male screw, which is engraved the designated segment ID number, and an lower endplug engraved the designated pin ID number. Taking account of the restriction on the transport container, the overall length of a lower pellet fuel segment is should be 459.9mm. In consideration of the dimension of the fabricated cladding for delivery, the cladding inner and outer diameter has been specified as 6.70±0.03mm and 7.50±0.03mm, respectively (already fabricated). The fuel stack length should be 250mm. A thermal insulator pellet specified as 10±1mm height is arranged above and below the MOX fuel stack. Due to possibility to construct the fuel stack without using any adjusting pellet, the tolerance of the fuel stack length and the length of a pellet has been specified as ±5mm and 10±1mm, respectively. The lower pellet fuel segment for the PTM test should have a plenum sleeve of 50mm length. A plenum spring is arranged between the plenum sleeve and the thermal insulator pellet. In consideration of transporting from Switzerland to Netherlands, the free length and the length in common use has been specified as 100±2mm and 80±8mm, respectively, from a viewpoint of ensuring the fixation of the fuel stack under the loading force due to acceleration of 6G. From a result of the plenum design, the overall cladding length has been specified as 410±0.5mm. The welding procedure for the upper endplug has to be assured by the qualification test (see section 5). The welding depth should be more than cladding thickness. The outer diameter at the welded bead between the upper endplug and the cladding should not exceed 7.65mm. The loose contamination on the surface should be less than 0.04Bq/cm^2. He gas of >95% purity should be filled in the fuel segment, and the rest should be nitrogen only. He leak rate should not exceed 3x10^{-7}mbar·l/sec (3x10^{-9}Pa·m^3/sec) in the He leak test. There should be no remarkable coloring and under-cut on the weld zone. There should be no crack, inclusion, pinhole, and blowhole exceeding 0.2mm at the weld zone. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(5) SPHERE-PAC FUEL SEGMENT (LOWER)

The revised drawing of the lower sphere-pac fuel segment is shown in **SPFH0-2PM-02007**. The lower segment of the sphere-pac fuel should have an upper connection endplug with a male screw, which is engraved the designated segment ID number, and a lower endplug. Taking account of the restriction on the transport container, the overall length of a lower segment of the sphere-pac fuel should be 459.9mm. In consideration of the dimension of the fabricated cladding for delivery, the cladding inner and outer diameter has been specified as 6.70±0.03mm and 7.50±0.03mm, respectively (already fabricated). In order to prevent broken particles going into a narrow gap between the upper connection endplug and the cladding, a fuel seal disc (FSD) made of tungsten is arranged between the upper connection endplug and the region of thermal insulator spheres. The fuel stack length has been specified as 250±5mm, similar to the pellet fuel segment for PTM test. The region of thermal insulator spheres specified as 10±1mm length is arranged above and below the MOX or Np-MOX spheres fuel stack. In order to fix the fuel stack, a particle retainer is arranged at the end of the region of spheres. The length of a special plenum sleeve has been specified as 118±8mm so that the cladding length should be the same as the pellet fuel segment. The overall cladding length has been specified as 410±0.5mm, similar to the pellet fuel segment. The welding procedure for the lower endplug has to be assured by the qualification test (see section 5). The welding depth should be more than cladding thickness. The outer diameter at the welded bead between the lower endplug and the cladding should not exceed 7.65mm. The loose contamination on the surface should be less than 0.04Bq/cm^2. He gas of >95% purity should be filled in the fuel segment, and the rest should be nitrogen only. He leak rate should not exceed 3x10^{-7}mbar·l/sec (3x10^{-9}Pa·m^3/sec) in the He leak test. There should be no remarkable coloring and under-cut on the weld zone. There should be no crack, inclusion, pinhole, and blowhole exceeding 0.2mm at the weld zone. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(6) VIPAC FUEL SEGMENT (LOWER)

The revised drawing of the vipac fuel segment is shown in **SPFH0-2PM-02008**. The vipac fuel segment should be fabricated as the only lower fuel segment. The vipac fuel should have an upper connection endplug with a male screw, which is engraved the designated segment ID number, and a lower endplug. Taking account of the restriction on the transport container, the overall length of a vipac fuel segment should be 459.9mm. In consideration of the dimension of the fabricated cladding for delivery, the cladding inner and outer diameter has been specified as 6.70±0.03mm and 7.50±0.03mm, respectively (already fabricated). In order to prevent broken particles going into a narrow gap between the upper connection endplug and the cladding, a fuel seal disc (FSD) made of tungsten is arranged between the upper connection endplug and the region of thermal insulator spheres. In addition, in order to prevent the intermixing taking place between thermal insulator spheres and fuel particles, FSD is arranged also between thermal insulator spheres and fuel particles. The fuel stack length has been specified as 250±5mm, similar to the pellet fuel segment for PTM test. The region of thermal insulator spheres specified as 10±1mm length is arranged above and below the MOX vipac fuel stack. In order to fix the fuel stack, a particle retainer is arranged at the end of the region of spheres. The length of a special plenum sleeve has been specified as 118±8mm so that the cladding length should be the same as the pellet fuel segment. The overall cladding length has been specified as 410±0.5mm, similar to the pellet fuel segment. The welding procedure for the lower endplug has to be assured by the qualification test (see section 5). The welding depth should be more than cladding thickness. The outer diameter at the welded bead between the lower endplug and the cladding should not exceed 7.65mm. The loose contamination on the surface should be less than 0.04Bq/cm^2. He gas of >95% purity should be filled in the fuel segment, and the rest should be nitrogen only. He leak rate should not exceed 3x10^{-7} mbar·l/sec (3x10^{-9}Pa·m^3/sec) in the He leak test. There should be no remarkable coloring and under-cut on the weld zone. There should be no crack, inclusion, pinhole, and blowhole exceeding 0.2mm at the weld zone. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(7) UPPER ENDPLUG (SPFH0-4PM-00042)

The drawing of the upper endplug is shown in **SPFH0-4PM-01008**. Taking account of the restriction on PSI's welding chamber, the length of an upper endplug has been specified as 40±0.1mm. In order to prevent the outer surface of the upper endplug protruding from the cladding surface, the upper limit of the upper endplug outer diameter has been specified as 7.5mm. The upper endplug should be engraved the designated pin ID number with a letter size of 2.8mm height. From a viewpoint of insertability into the cladding, the upper endplug has a chamfer of 2° and a cylindrical part of 1.5mm length on the welding joint side. Taking account of the cladding inner diameter, the outer diameter at a cylindrical part has been specified as 6.68±0.01mm (as well as the connection endplug). From a result of the first welding test in PSI, a groove at the welding joint has been removed. In order to prevent bowing after welding the upper endplug to the cladding, the verticality of the welding joint surface to the endplug surface and the center of the overall endplug and welding joint diameter has been specified. In order to assure that the sodium could exist between the molybdenum shroud and the fuel rod, the upper endplug should have three projections (0.40mm thickness x 2mm width x 2mm height) at intervals of 120°. The thickness of a projection (0.40mm) has been decided so that the outer diameter of the upper endplug would be similar to one of the lower endplug (8.30±0.03mm). In consideration of the quality of the bar material for the component delivery, the upper endplug should be made of PNC1520. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(8) LOWER ENDPLUG

The drawing of the lower endplug is shown in **SPFH0-4PM-01009**. Taking account of the restriction on PSI's welding chamber, the length of a lower endplug has been specified as 40±0.1mm. In order to prevent the outer surface of the lower endplug protruding from the cladding surface, the upper limit of the lower endplug outer diameter has been specified as 7.5mm. From a viewpoint of insertability into the cladding, the lower endplug has a chamfer of 2° and a cylindrical part of 1.5mm length on the welding joint side. Taking account of the cladding inner diameter, the outer diameter at a cylindrical part has been specified as 6.68±0.01mm (as well as the connection endplug). From a result of the first welding test in PSI, a groove at the welding joint has been removed. In order to prevent bowing after welding the lower endplug to the cladding, the verticality of the welding joint surface to the endplug surface and the center of the overall endplug and welding joint diameter has been specified. In consideration of the quality of the bar material for the component delivery, the lower endplug should be made of PNC1520. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(9) CLADDING WITH CONNECTION ENDPLUG

The drawing of the cladding with connection endplug is shown in **SPFH0-2PM-01038**. The upper and lower connection endplug should be beforehand welded with the cladding at JNC, respectively. The welding procedure for the connection endplug has to be assured by the qualification test (see section 5). The bead diameter at the welded joint should not exceed 7.65mm. The overall bowing after connecting should be less than 1.0mm. In order to assure the closure at the weld zone, the He leak test should be performed. He leak rate should not exceed $3\mathrm{x}10^{-7}$mbar·l/sec ($3\mathrm{x}10^{-9}$Pa·m^3/sec). There should be no remarkable coloring and under-cut on the weld zone. There should be no crack, inclusion, pinhole, and blowhole exceeding 0.2mm at the weld zone. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(10) CLADDING

The drawing of the cladding is shown in **SPFH0-4PM-01011**. The overall length of a cladding has been specified as 410±0.5mm. In consideration of the dimension of the fabricated cladding for delivery, the cladding inner and outer diameter has been specified as 6.70±0.03mm and 7.50±0.03mm, respectively (already fabricated). In order to prevent bowing after welding the endplug with the cladding, the verticality of the welding joint surface to the cladding surface has been specified. In consideration of the cladding material for the component delivery, the cladding should be made of PNC1520 (already fabricated). There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(11) UPPER CONNECTION ENDPLUG

The drawing of the upper connection endplug is shown in **SPFH0-3PM-01039**. The overall length of the upper connection endplug has been specified as 19.9±0.1mm. The upper endplug has a male screw and a flat surface of 4.5mm width on the side to hold easily with a wrench of 3mm thickness. In order to prevent the outer surface of the upper connection endplug protruding from the cladding surface, the upper limit of the upper connection endplug outer diameter has been specified as 7.5mm. From a viewpoint of insertability into the cladding, the upper connection endplug has a chamfer of 2° and a cylindrical part of 1.5mm length on the welding joint side. Taking account of the cladding inner diameter, the outer diameter at a cylindrical part has been specified as 6.68±0.01mm. From a result of the first welding test in PSI, a groove on the welding joint has been removed. The connecting joint corner should be cut to be a groove of 1.0mm depth after the connection. The upper connection endplug should be engraved the designated segment ID with a letter size of 2mm height. In order to prevent bowing after welding the upper connection endplug to the cladding, the verticality of the welding joint surface to the endplug surface, and the center of the overall endplug and welding joint diameter has been specified. In addition, in order to prevent remarkable pin bowing, the verticality of the connecting joint surface to the endplug surface, and the center of the overall endplug and the male screw has been specified. In consideration of the quality of the bar material for the component delivery, the upper connection endplug should be made of PNC1520. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(12) LOWER CONNECTION ENDPLUG

The drawing of the lower connection endplug is shown in **SPFH0-3PM-01040**. The overall length of the lower connection endplug has been specified as 15±0.1mm. The lower endplug has a female screw and a flat surface of 4.5mm width on the side to hold easily with a wrench of 3mm thickness. In order to prevent the outer surface of the lower connection endplug protruding from the cladding surface, the upper limit of the lower connection endplug outer diameter has been specified as 7.5mm. From a viewpoint of insertability into the cladding, the lower connection endplug has a chamfer of 2° and a cylindrical part of 1.5mm length on the welding joint side. Taking account of the cladding inner diameter, the outer diameter at a cylindrical part has been specified as 6.68±0.01mm. From a result of the first welding test in PSI, a groove on the welding joint has been removed. The connecting joint corner should be cut to be a groove of 1.0mm depth after the connection. The lower connection endplug should be engraved the designated segment ID number with a letter size of 2mm height. In order to prevent bowing after welding the lower connection endplug to the cladding, the verticality of the welding joint surface to the endplug surface, and the center of the overall endplug and welding joint diameter has been specified. In addition, in order to prevent remarkable pin bowing, the verticality of the connecting joint surface to the endplug surface, and the center of the overall endplug and the female screw has been specified. In consideration of the quality of the bar material for the component delivery, the upper connection endplug should be made of PNC1520. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(13) SPACER

The drawing of the spacer is shown in **SPFH0-4PM-01014**. A spacer assures that the sodium could exist between the molybdenum shroud and the fuel rod. A spacer should have three projections at intervals of 120°. Taking into account the restriction on the molybdenum shroud, the maximum diameter of projections has been specified as 7.90±0.03mm. The thickness of a spacer has been specified as 2+0.05/0mm. In order to prevent the difference of property between a spacer and the connection endplug, the spacer should be made of PNC1520. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(14) PLENUM SPRING

The drawing of the plenum spring is shown in **SPFH0-4PM-01015**. The plenum spring should be used for the pellet fuel segment. In consideration of transporting from Switzerland to Holland, the plenum spring has been designed from a viewpoint of ensuring the fixation of the fuel stack under the loading force due to 6G. The free length has been specified as 100±2mm, and the length in common use has been specified as 80±8mm. The spring constant has been specified as 0.642±0.042N/mm. The nominal spring load should be 12.835N. The plenum spring should be made of SUS304WPB. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(15) PLENUM SLEEVE (PELLET FUEL SEGMENT)

The drawing of the plenum sleeve in the pellet fuel segment is shown in **SPFH0-4PM-01016**. The overall length of the plenum sleeve has been specified as 50±0.3mm. In order to confirm the insertabiliy into the cladding, the plenum sleeve bowing should be inspected by an inspection gauge of 6.60mm diameter and 20mm length. In addition, the fabricated plenum sleeve should be assured to be able to be mounted into the cladding. In consideration of the quality of the bar material for the component delivery, the plenum sleeve should be made of PNC1520. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(16) PLENUM SLEEVE CAP (PELLET FUEL SEGMENT)

The drawing of the plenum sleeve cap in the pellet fuel segment is shown in **SPFH0-4PM-01017**. The outer diameter of the plenum sleeve cap should be similar to the outer diameter of the plenum sleeve tube (6.4mm). The fabrication tolerance of the cap outer diameter has been specified as ±0.02mm that is somewhat tighter than of the tube outer diameter (±0.05mm). The cap outer diameter on the joint side with the sleeve tube should be similar to the inner diameter of the sleeve tube. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(17) PLENUM SLEEVE TUBE (PELLET FUEL SEGMENT)

The drawing of the plenum sleeve tube in the pellet fuel segment is shown in **SPFH0-4PM-01018**. In order to keep 20%CW, the plenum sleeve tube should be made by not drawing but machining. Taking account of machinability (no influence of machining on sleeve tube bowing, etc.), the thickness of the sleeve tube and the joint with the cap, and the overall length has been specified as (0.8)mm, (0.4)mm, and 49±0.1mm, respectively. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(18) SPECIAL PLENUM SLEEVE (SPHERE-PAC OR VIPAC FUEL SEGMENT)

The drawing of the special plenum sleeve in the sphere-pac or vipac fuel segment is shown in **SPFH0-3PM-01019**. A special plenum sleeve should consist of a plenum sleeve, a fixation nut, and a distance screw. The length of a special plenum sleeve should be adjusted to the suitable length (L4) for each fuel segment with a distance screw, and fixed the length with a fixation nut. A special plenum sleeve, of which length (L4) is beforehand adjusted, should be loaded into the cladding after fixed the fuel stack by a particle retainer. The conical shape of the plenum sleeve cap on one side can relax the fixation of a particle retainer on the cladding inner surface. The depth of a cone on the sleeve cap has been specified as 1.5mm so that the length of “small spring”, which is the gap between a special plenum sleeve and the particle retainer after mounting, would be more than

0.8mm. A special plenum sleeve including a distance screw (L4=127) should be assumed to be mounted into the cladding. In order to prevent the difference of property between a special plenum sleeve and the cladding, all components included in a special plenum sleeve should be made of PNC1520. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(19) PLENUM SLEEVE (SPHERE-PAC OR VIPAC FUEL SEGMENT)

The drawing of the plenum sleeve in the sphere-pac or vipac fuel segment is shown in **SPFH0-4PM-01020**. The overall length of the plenum sleeve has been specified as 71.7±0.3mm. A plenum sleeve should have a cap with conical shape on one side. A plenum sleeve should be pass through the inspection gauge (inner diameter: 6.60mm, length: 20mm). There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(20) PLENUM SLEEVE CAP1 (SPHERE-PAC OR VIPAC FUEL SEGMENT)

The drawing of one of the plenum sleeve cap in the sphere-pac or vipac fuel segment is shown in **SPFH0-4PM-01021**. The outer diameter of the plenum sleeve cap should be similar to the outer diameter of the plenum sleeve tube (6.4mm). The fabrication tolerance of the cap outer diameter has been specified as ±0.02mm that is somewhat tighter than of the tube outer diameter (±0.05mm). The cap outer diameter on the joint side with the sleeve tube should be similar to the inner diameter of the sleeve tube. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(21) PLENUM SLEEVE CAP2 (SPHERE-PAC OR VIPAC FUEL SEGMENT)

The drawing of one of the plenum sleeve cap in the sphere-pac or vipac fuel segment is shown in **SPFH0-4PM-01022**. The outer diameter of the plenum sleeve cap should be similar to the outer diameter of the plenum sleeve tube (6.4mm). The fabrication tolerance of the cap outer diameter has been specified as ±0.02mm that is somewhat tighter than of the tube outer diameter (±0.05mm). The cap outer diameter on the joint side with the sleeve tube should be similar to the inner diameter of the sleeve tube. A plenum sleeve cap should have the conical shape to relax the fixation of a particle retainer on the cladding inner surface. In order that a particle retainer could smoothly slip, the roughness on the conical surface has been specified as N5. In addition, in order to relax the fixation of a particle retainer evenly, the verticality of the bottom surface of the cone to the cap surface has been specified. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(22) PLENUM SLEEVE TUBE (SPHERE-PAC OR VIPAC FUEL SEGMENT)

The drawing of the plenum sleeve tube in the sphere-pac or vipac fuel segment is shown in **SPFH0-4PM-01023**. In order to keep 20%CW, the plenum sleeve tube should be made by not drawing but machining. Taking account of machinability (no influence of machining on sleeve tube bowing, etc.), the thickness of the sleeve tube and the joint with the cap, and the overall length has been specified as (0.8)mm, (0.4)mm, and 69.2±0.1mm, respectively. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(23) DISTANCE SCREW (SPHERE-PAC OR VIPAC FUEL SEGMENT)

The drawing of the distance screw in the sphere-pac or vipac fuel segment is shown in **SPFH0-4PM-01024**. The length of the distance screw has been specified as 60±0.2mm. The outer diameter of the screw head has been specified as 6.2±0.02mm to insert a special plenum sleeve into cladding easily. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(24) FIXATION NUT (SPHERE-PAC OR VIPAC FUEL SEGMENT)

The drawing of the fixation nut in the sphere-pac or vipac fuel segment is shown in **SPFH0-4PM-01025**. The thickness of a fixation nut has bees specified as 3±0.1mm. The outer diameter of a fixation nut has been specified as 6.2±0.02mm, similar to the outer diameter of the distance screw. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(25) PARTICLE RETAINER (SPHERE-PAC OR VIPAC FUEL SEGMENT)

The drawing of the particle retainer in the sphere-pac or vipac fuel segment is shown in **SPFH0-4PM-01026**. The particle retainer should be made of the same material as the cladding (PNC1520). It keeps the fuel stack in place during the segment fabrication at PSI. After the closure welding, the particle retainer fixation is relaxed by a special plenum sleeve. With this construction, no initial radial stress will be on the cladding inner surface due to a particle retainer, and the fuel stack will be mechanical fixed in axial direction (More safety during the transportation than with a plenum spring, no expansion of the fuel stack will be possible). The overall length of a particle retainer has been specified as 12mm. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(26) FUEL SEAL DISC (SPHERE-PAC OR VIPAC FUEL SEGMENT)

The revised drawing of the fuel seal disc (FSD) in the sphere-pac or vipac fuel segment is shown in **SPFH0-4PM-01027**. Taking account of the difference of thermal expansion coefficient and stability during irradiation, the FSD should be made of tungsten. Taking account of the maximum and minimum cladding inner diameter for the delivery (6.704mm and 6.675mm), the FSD outer diameter has been specified as 6.65±0.015mm so that a gap between the FSD and the cladding would be less than a half of the insulator particle diameter. The thickness of FSD should be 0.10±0.05mm. There should be no harmful crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(27) MOX FUEL PELLET

The drawing of the MOX fuel pellet in the pellet fuel segment is shown in **SPFH0-4PM-02009**. The MOX fuel pellet should have the Pu content of 20wt%. The height of a MOX fuel pellet loaded into the pellet fuel segment has been specified as 10±1mm so that the MOX fuel stack specified as 250±5mm length could be constructed without any adjusting pellet. From a viewpoint of imitation of the radial temperature profile in the irradiation test, the MOX fuel pellet diameter has been specified as 6.5±0.05mm. The MOX fuel pellet has a chamfer of 0.40mm x 0.13mm at the edge of the loading surface to prevent chips taking place. The density and O/M ratio of the MOX fuel pellet has been specified as 95±2%T.D. and 1.97+0.02/-0.03, respectively. The target O/M ratio should be 1.97. There should be no harmful chip, crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

(28) THERMAL INSULATOR PELLET

The drawing of the thermal insulator pellet in the pellet fuel segment is shown in **SPFH0-4PM-01029**. The thermal insulator pellet should made of the depleted UO_2. The height and the diameter of a thermal insulator pellet have been specified as 10±1mm and 6.5±0.05mm, similar to the MOX fuel pellet. The thermal insulator pellet has a chamfer of 0.40mm x 0.13mm at the edge of the loading surface to prevent chips taking place. The density and O/U ratio of the thermal insulator pellet has been specified as 95±2%T.D. and 2.00~2.02, respectively. There should be no harmful chip, crack, flaw etc. on the surface. There should be no harmful stickiness (oils and fats, oxide etc.) on the surface.

Attachment A

Fabrication Drawing "SPF IRRADIATION TEST IN HFR"

DRAWING LIST

PROJECT NAME			
SPF IRRADIATION TEST IN HFR			
No.	DRAWING NO.	TITLE	APPROVAL & REVISION DATE
1	SPFH0-2PM-02003	FUEL ROD	21/1
2	SPFH0-2PM-02004	PELLET FUEL SEGMENT (UPPER)	21/1
3	SPFH0-2PM-02005	SPHERE-PAC FUEL SEGMENT (UPPER)	21/1
4	SPFH0-2PM-02006	PELLET FUEL SEGMENT (LOWER)	21/1
5	SPFH0-2PM-02007	SPHERE-PAC FUEL SEGMENT (LOWER)	21/1
6	SPFH0-2PM-02008	VIPAC FUEL SEGMENT (LOWER)	21/1
7	SPFH0-4PM-01008	UPPER ENDPLUG	5/3
8	SPFH0-4PM-01009	LOWER ENDPLUG	5/3
9	SPFH0-2PM-01038	CLADDING WITH CONNECTION ENDPLUG	12/10
10	SPFH0-4PM-01011	CLADDING	5/3
11	SPFH0-3PM-01039	UPPER CONNECTION ENDPLUG	12/10
12	SPFH0-3PM-01040	LOWER CONNECTION ENDPLUG	12/10
13	SPFH0-4PM-01014	SPACER	5/3
14	SPFH0-4PM-01015	PLENUM SPRING	5/3
15	SPFH0-4PM-01016	PLENUM SLEEVE (PELLET FUEL SEGMENT)	5/3
16	SPFH0-4PM-01017	PLENUM SLEEVE CAP (PELLET FUEL SEGMENT)	5/3
17	SPFH0-4PM-01018	PLENUM SLEEVE TUBE (PELLET FUEL SEGMENT)	5/3
18	SPFH0-3PM-01019	SPECIAL PLENUM SLEEVE (SPHERE-PAC OR VIPAC FUEL SEGMENT)	5/3
19	SPFH0-4PM-01020	PLENUM SLEEVE (SPHERE-PAC OR VIPAC FUEL SEGMENT)	5/3

MARK	CHANGE	NAME	DATE

	NAME	DATE	CLASSIFICATION
DWG.	M. Nagayama	17.1.2002	① ~~PLELIMINARY~~
CHECK	H. Nakazawa	21.1.2002	② MANUFACTURE
APPR.	T. Abe	21.1.2002	③ ~~FINISHED~~
			④

DRAWING NO.
SPFH0-4LM-02001

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

DRAWING LIST

PROJECT NAME			
SPF IRRADIATION TEST IN HFR			
No.	DRAWING NO.	TITLE	APPROVAL & REVISION DATE
20	SPFH0-4PM-01021	PLENUM SLEEVE CAP (1) (SPHERE-PAC OR VIPAC FUEL SEGMENT)	5/3
21	SPFH0-4PM-01022	PLENUM SLEEVE CAP (2) (SPHERE-PAC OR VIPAC FUEL SEGMENT)	5/3
22	SPFH0-4PM-01023	PLENUM SLEEVE TUBE (SPHERE-PAC OR VIPAC FUEL SEGMENT)	5/3
23	SPFH0-4PM-01024	DISTANCE SCREW (SPHERE-PAC OR VIPAC FUEL SEGMENT)	5/3
24	SPFH0-4PM-01025	FIXATION NUT (SPHERE-PAC OR VIPAC FUEL SEGMENT)	5/3
25	SPFH0-4PM-01026	PARTICLE RETAINER (SPHERE-PAC OR VIPAC FUEL SEGMENT)	5/3
26	SPFH0-4PM-01027	FUEL SEAL DISC (SPHERE-PAC OR VIPAC FUEL SEGMENT)	5/3
27	SPFH0-4PM-02009	MOX FUEL PELLET	2/1
28	SPFH0-4PM-01029	THERMAL INSULATOR PELLET	5/3
29			
30			
31			
32			
33			
34			
35			
36			
37			
38			

MARK	CHANGE	NAME	DATE

	NAME	DATE
DWG.	M. Nagayama	.7.1.2002
CHECK	H. Nakazawa	21.1.2002
APPR.	T. Abe	21.1.2002

CLASSIFICATION

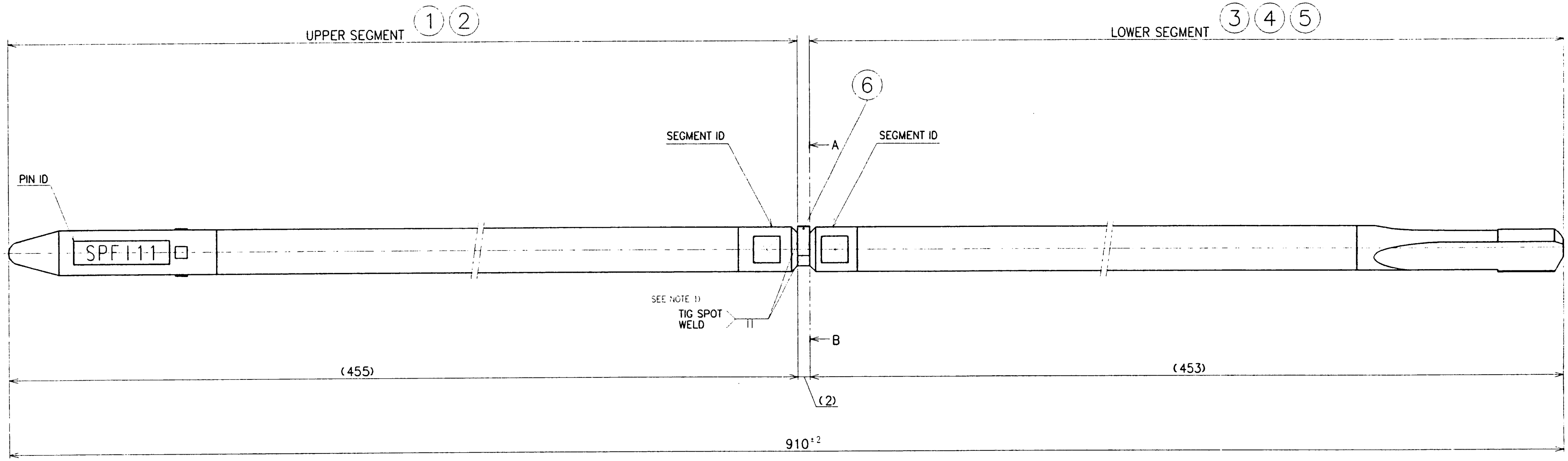
1. ~~PLELIMINARY~~
2. MANUFACTURE
3. ~~FINISHED~~
4.

DRAWING NO.
SPFH0-4LM-02002

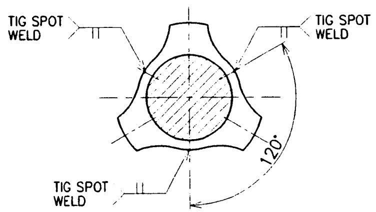
JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE

MARK	CHANGE	NAME	DATE



		KAKADU FACILITY							
		INITIAL SINTERING		RESTRUCTURING (1)		RESTRUCTURING (2)		P T M	
UPPER SEGMENT	FUEL TYPE	MOX	MOX	MOX	MOX	MOX	MOX	MOX	MOX
	FUEL FORM	PELLET	SPHERE	PELLET	SPHERE	PELLET	SPHERE	PELLET	SPHERE
	SEGMENT ID	I11U	I12U	R11U	R12U	R21U	R22U	P11U	P12U
	ITEM NO.	1	2	1	2	1	2	1	2
LOWER SEGMENT	FUEL TYPE	MOX	MOX	MOX	Np-MOX	MOX	MOX	MOX	Np-MOX
	FUEL FORM	SPHERE	VIPAC	SPHERE	SPHERE	SPHERE	VIPAC	PELLET	SPHERE
	SEGMENT ID	I11L	I12L	R11L	R12L	R21L	R22L	P11L	P12L
	ITEM NO.	4	5	4	4	4	5	3	4
PIN ID		SPFI11	SPFI12	SPFR11	SPFR12	SPFR21	SPFR22	SPFP11	SPFP12



A–B CROSS SECTION (5/1)

ITEM	DRAWING NO.	NAME	MATERIAL	NUM.	REMARKS
6	01014	SPACER	PNC1520	8	
5	02008	VIPAC FUEL SEGMENT (LOWER)		2	
4	02007	SPHERE-PAC FUEL SEGMENT (LOWER)		5	
3	02006	PELLET FUEL SEGMENT (LOWER)		1	
2	02005	SPHERE-PAC FUEL SEGMENT (UPPER)		4	
1	02004	PELLET FUEL SEGMENT (UPPER)		4	

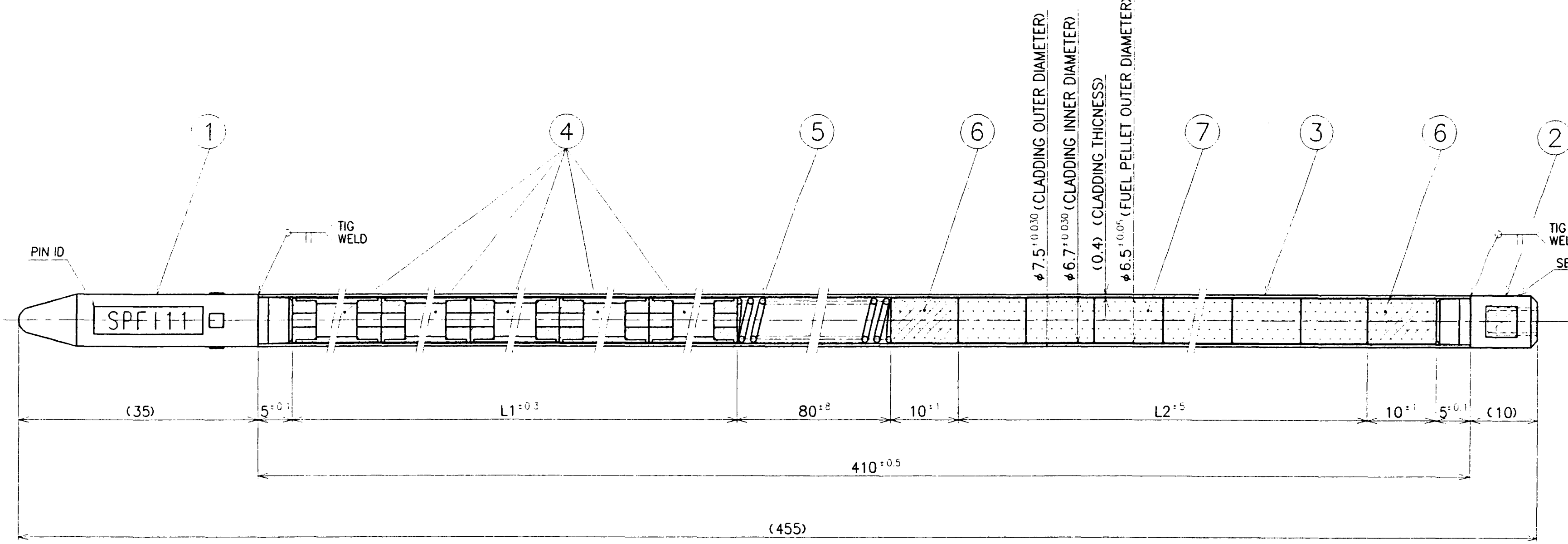
NOTE

1) TIG SPOT WELDING SHOULD BE PERFORMED AT INTERVALS OF 120° ON NO PROJECTION PART.
2) OVERALL BOWING OF THE FUEL PIN CONSISTING OF THE ASSEMBLED FUEL SEGMENTS SHOULD BE LESS THAN 1.5MM. (AIMED AT LESS THAN 1.0MM).
3) ACCORDING TO THE FOLLOWING TABLE, THE UPPER AND LOWER FUEL SEGMENT SHOULD BE CONNECTED.
4) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.
5) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ANGLE		DESIGN	DWG.	CHECK	APPR.
THIRD	NAME	[illegible]	[illegible]	[illegible]	[illegible]
	DATE	17. 1. 2002	17. 1. 2002	21. 1. 2002	24. 1. 2002
SCALE	TITLE SPF IRRADIATION TEST IN HFR FUEL ROD				
2/1 (5/1)	DRAWING NO. SPFH0-2PM-02003				

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

MARK	CHANGE	NAME	DATE



	L1	L2	REMARKS
1	50	250	PTM TEST
2	250	50	INITIAL SINTERING & RESTRUCTURING TEST

NOTE

1) THE PURITY OF HE GAS FILLED IN FUEL SEGMENT SHOULD BE MORE THAN 95%. THE REST SHOULD BE NITROGEN ONLY.
2) BEAD DIAMETER AT THE WELDED JOINT SHOULD BE LESS THAN 7.65MM.
3) THERE SHOULD BE NO REMARKABLE COLOURING AND UNDER CUT ON THE WELD ZONE.
4) HE LEAK TEST SHOULD BE PERFORMED. HE LEAK RATE SHOULD NOT EXCEED 3×10^{-7} MBAR·L/SEC.
5) LOOSE CONTAMINATION ON THE SURFACE SHOULD BE LESS THAN 0.04BQ/CM^2.
6) THERE SHOULD BE NO CRACK, INCLUSION, PINHOLE AND BLOWHOLE EXCEEDING 0.2MM AT THE WELD ZONE.
7) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.
8) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUM.	REMARKS
7	02009	MOX FUEL PELLET	PuO_2-UO_2		
6	01029	THERMAL INSULATOR PELLET	DEPLETED UO_2	2	
5	01015	PLENUM SPRING	SUS304WPB	1	
4	01016	PLENUM SLEEVE	PNC1520	PTM ; 1 INITIAL RESTRUCTURE ; 5	
3	01011	CLADDING	PNC1520	1	
2	01040	LOWER CONNECTION ENDPLUG	PNC1520	1	
1	01008	UPPER ENDPLUG	PNC1520	1	

ANGLE		DESIGN	DWG.	CHECK	APPR.
THIRD	NAME	T. Gam	M. Yamayama	H. Nakagawa	T. Abe
	DATE	17. 1. 2002	17. 1. 2002	21. 1. 2002	21. 1. 2002

TITLE SPF IRRADIATION TEST IN HFR

PELLET FUEL SEGMENT (UPPER)

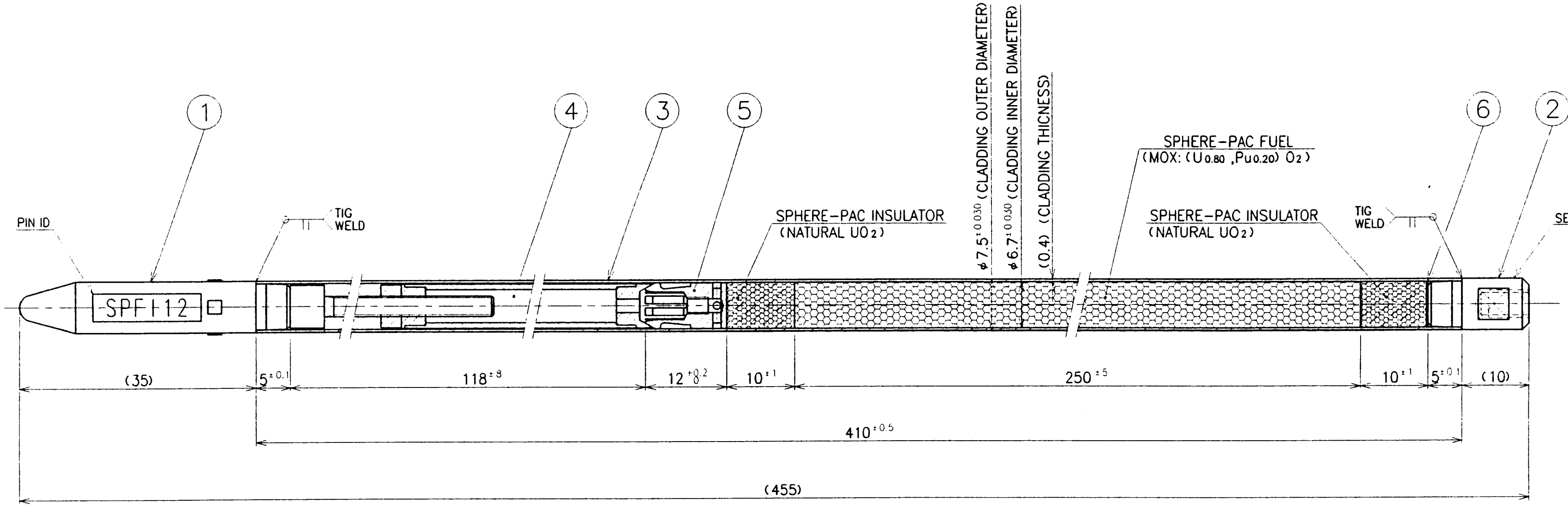
SCALE 2/1

DRAWING NO. SPFH0-2PM-02004

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE

MARK	CHANGE	NAME	DATE



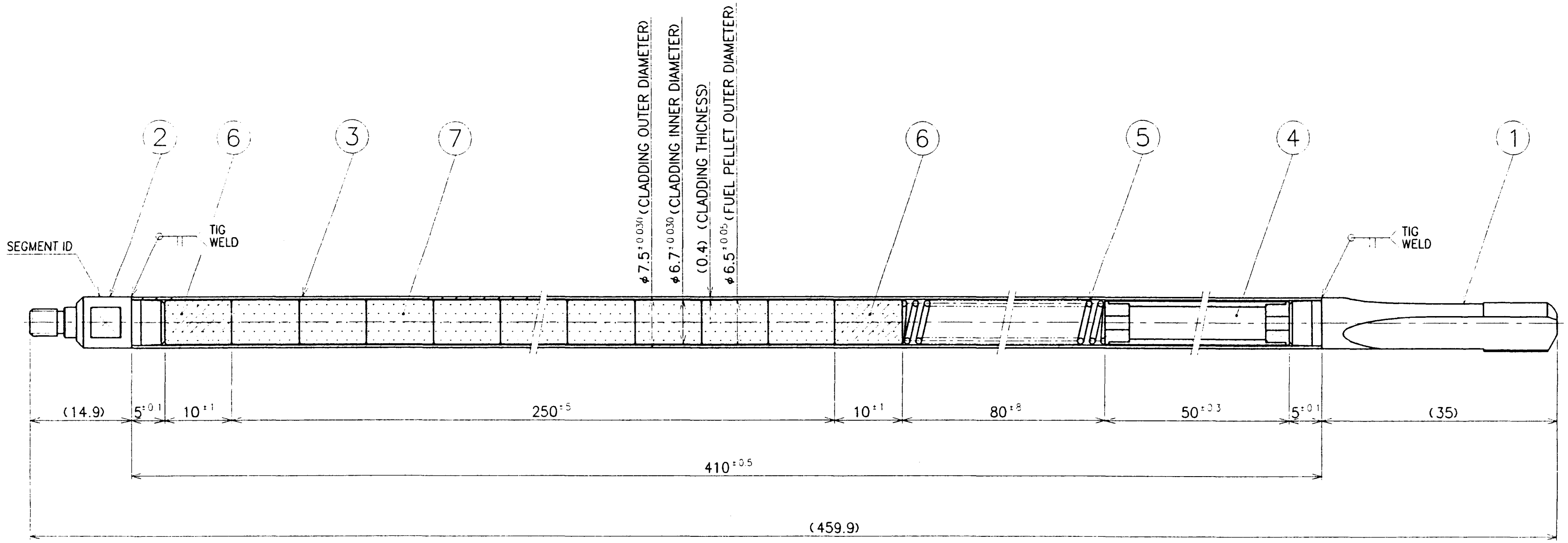
NOTE

1) THE PURITY OF HE GAS FILLED IN FUEL SEGMENT SHOULD BE MORE THAN 95%. THE REST SHOULD BE NITROGEN ONLY.
2) BEAD DIAMETER AT THE WELDED JOINT SHOULD BE LESS THAN 7.65MM.
3) THERE SHOULD BE NO REMARKABLE COLOURING AND UNDER CUT ON THE WELD ZONE.
4) HE LEAK TEST SHOULD BE PERFORMED. HE LEAK RATE SHOULD NOT EXCEED 3×10^{-7}MBAR·L/SEC.
5) LOOSE CONTAMINATION ON THE SURFACE SHOULD BE LESS THAN 0.04BQ/CM^2.
6) THERE SHOULD BE NO CRACK, INCLUSION, PINHOLE AND BLOWHOLE EXCEEDING 0.2MM AT THE WELD ZONE.
7) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.
8) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUM.	REMARKS
6	01027	FUEL SEAL DISC	W	1	
5	01026	PARTICLE RETAINER	PNC1520	1	
4	01019	SPECIAL PLENUM SLEEVE	PNC1520	1	
3	01011	CLADDING	PNC1520	1	
2	01040	LOWER CONNECTION ENDPLUG	PNC1520	1	
1	01008	UPPER ENDPLUG	PNC1520	1	

ANGLE		DESIGN	DWG.	CHECK	APPR.
THIRD	NAME	T. Ogawa	M. Tsuyuyama	K. Nakajima	T. Abe
	DATE	17.1.2002	17.1.2002	21.1.2002	21.1.2002
	TITLE SPF IRRADIATION TEST IN HFR				
SCALE	SPHERE–PAC FUEL SEGMENT (UPPER)				
2/1	DRAWING NO. SPFH0-2PM-02005				

MARK	CHANGE	NAME	DATE



NOTE

1) THE PURITY OF HE GAS FILLED IN FUEL SEGMENT SHOULD BE MORE THAN 95%. THE REST SHOULD BE NITROGEN ONLY.
2) BEAD DIAMETER AT THE WELDED JOINT SHOULD BE LESS THAN 7.65MM.
3) THERE SHOULD BE NO REMARKABLE COLOURING AND UNDER CUT ON THE WELD ZONE.
4) HE LEAK TEST SHOULD BE PERFORMED. HE LEAK RATE SHOULD NOT EXCEED 3×10^{-7}MBAR·L/SEC.
5) LOOSE CONTAMINATION ON THE SURFACE SHOULD BE LESS THAN 0.04BQ/CM^2.
6) THERE SHOULD BE NO CRACK, INCLUSION, PINHOLE AND BLOWHOLE EXCEEDING 0.2MM AT THE WELD ZONE.
7) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.
8) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUM.	REMARKS
7	02009	MOX FUEL PELLET	PuO_2-UO_2		
6	01029	THERMAL INSULATOR PELLET	DEPLETED UO_2	2	
5	01015	PLENUM SPRING	SUS304WPB	1	
4	01016	PLENUM SLEEVE	PNC1520	1	
3	01011	CLADDING	PNC1520	1	
2	01039	UPPER CONNECTION ENDPLUG	PNC1520	1	
1	01009	LOWER ENDPLUG	PNC1520	1	

ANGLE		DESIGN	DWG.	CHECK	APPR.
THIRD	NAME	T. Gaume	M. Kageyama	H. Nakajima	T. Abe
	DATE	17. 1. 2002	17. 1. 2002	21. 1. 2002	24. 1. 2002

TITLE SPF IRRADIATION TEST IN HFR

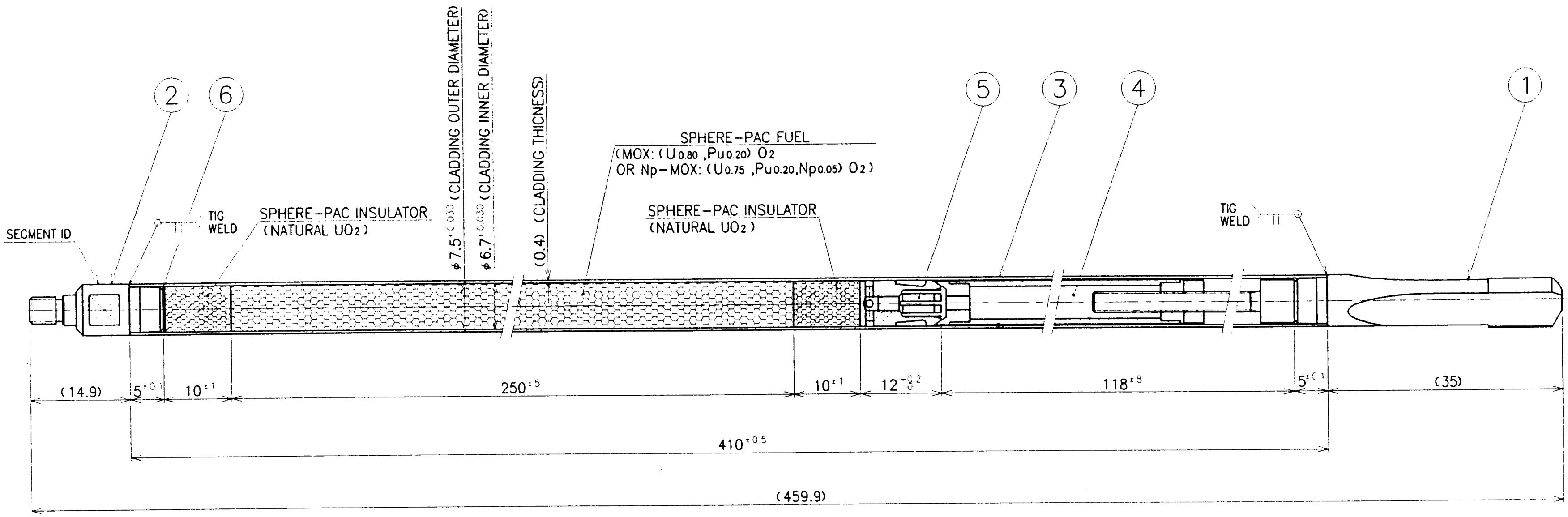
PELLET FUEL SEGMENT (LOWER)

SCALE 2/1

DRAWING NO. SPFHO-2PM-02006

REFERENCE

MARK	CHANGE	NAME	DATE



NOTE

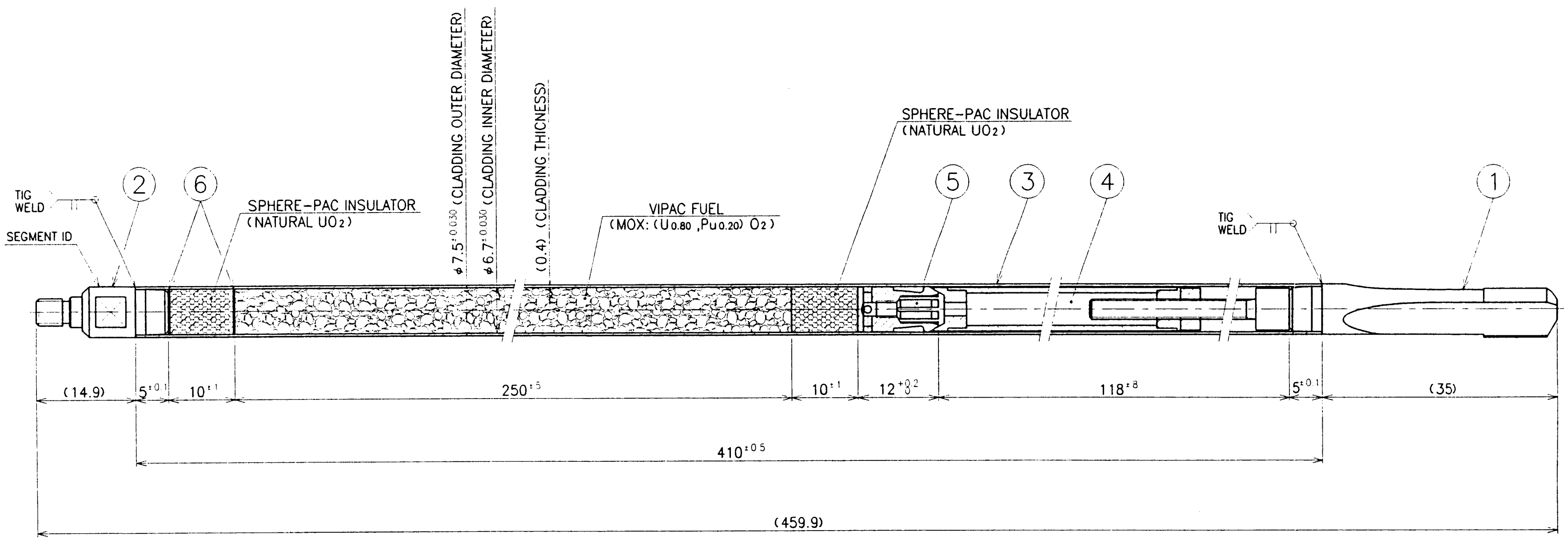
1) THE PURITY OF HE GAS FILLED IN FUEL SEGMENT SHOULD BE MORE THAN 95%. THE REST SHOULD BE NITROGEN ONLY.
2) BEAD DIAMETER AT THE WELDED JOINT SHOULD BE LESS THAN 7.65MM.
3) THERE SHOULD BE NO REMARKABLE COLOURING AND UNDER CUT ON THE WELD ZONE.
4) HE LEAK TEST SHOULD BE PERFORMED. HE LEAK RATE SHOULD NOT EXCEED 3×10^{-7} MBAR·L/SEC.
5) LOOSE CONTAMINATION ON THE SURFACE SHOULD BE LESS THAN 0.04BQ/CM^2.
6) THERE SHOULD BE NO CRACK, INCLUSION, PINHOLE AND BLOWHOLE EXCEEDING 0.2MM AT THE WELD ZONE.
7) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.
8) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUM.	REMARKS
6	01027	FUEL SEAL DISC	W	1	
5	01026	PARTICLE RETAINER	PNC1520	1	
4	01019	SPECIAL PLENUM SLEEVE	PNC1520	1	
3	01011	CLADDING	PNC1520	1	
2	01039	UPPER CONNECTION ENDPLUG	PNC1520	1	
1	01009	LOWER ENDPLUG	PNC1520	1	

ANGLE		DESIGN	DWG.	CHECK	APPR.
THIRD	NAME	T. Ogawa	N. Nakayama	K. Nakajima	T. Abe
	DATE	17.1.2002	17.1.2002	21 1 2002	21.1.2002
SCALE	TITLE SPF IRRADIATION TEST IN HFR SPHERE-PAC FUEL SEGMENT (LOWER)				
2/1 (/)	DRAWING NO. SPFHO-2PM-02007				

REFERENCE

MARK	CHANGE	NAME	DATE



NOTE

1) THE PURITY OF HE GAS FILLED IN FUEL SEGMENT SHOULD BE MORE THAN 95%. THE REST SHOULD BE NITROGEN ONLY.
2) BEAD DIAMETER AT THE WELDED JOINT SHOULD BE LESS THAN 7.65MM.
3) THERE SHOULD BE NO REMARKABLE COLOURING AND UNDER CUT ON THE WELD ZONE.
4) HE LEAK TEST SHOULD BE PERFORMED. HE LEAK RATE SHOULD NOT EXCEED 3×10^{-7} MBAR·L/SEC.
5) LOOSE CONTAMINATION ON THE SURFACE SHOULD BE LESS THAN 0.04BQ/CM^2.
6) THERE SHOULD BE NO CRACK, INCLUSION, PINHOLE AND BLOWHOLE EXCEEDING 0.2MM AT THE WELD ZONE.
7) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.
8) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUM.	REMARKS
6	01027	FUEL SEAL DISC	W	2	
5	01026	PARTICLE RETAINER	PNC1520	1	
4	01019	SPECIAL PLENUM SLEEVE	PNC1520	1	
3	01011	CLADDING	PNC1520	1	
2	01039	UPPER CONNECTION ENDPLUG	PNC1520	1	
1	01009	LOWER ENDPLUG	PNC1520	1	

ANGLE		DESIGN	DWG.	CHECK	APPR.
THIRD	NAME	T. Gaun	M. Nayayama	N. Nakayama	T. Abe
	DATE	17. 1. 2002	17. 1. 2002	21. 1. 2002	21. 2. 2002

TITLE SPF IRRADIATION TEST IN HFR

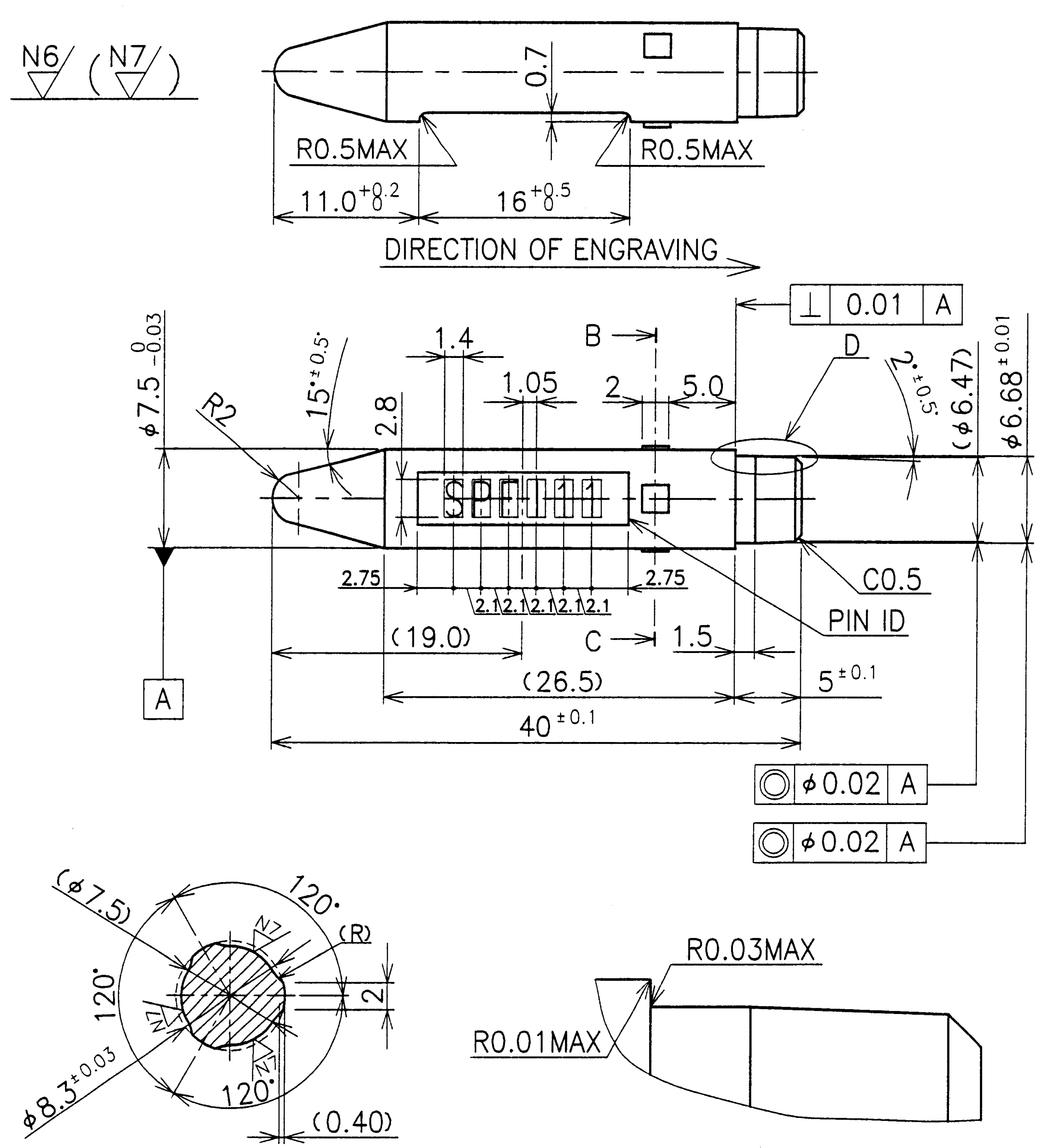
SCALE: 2/1

VIPAC FUEL SEGMENT (LOWER)

DRAWING NO. SPFH0-2PM-02008

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE		MARK	CHANGE	NAME	DATE



B–C CROSS SECTION

DETAILED DRAWING D (10/1)

NOTE

1) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.

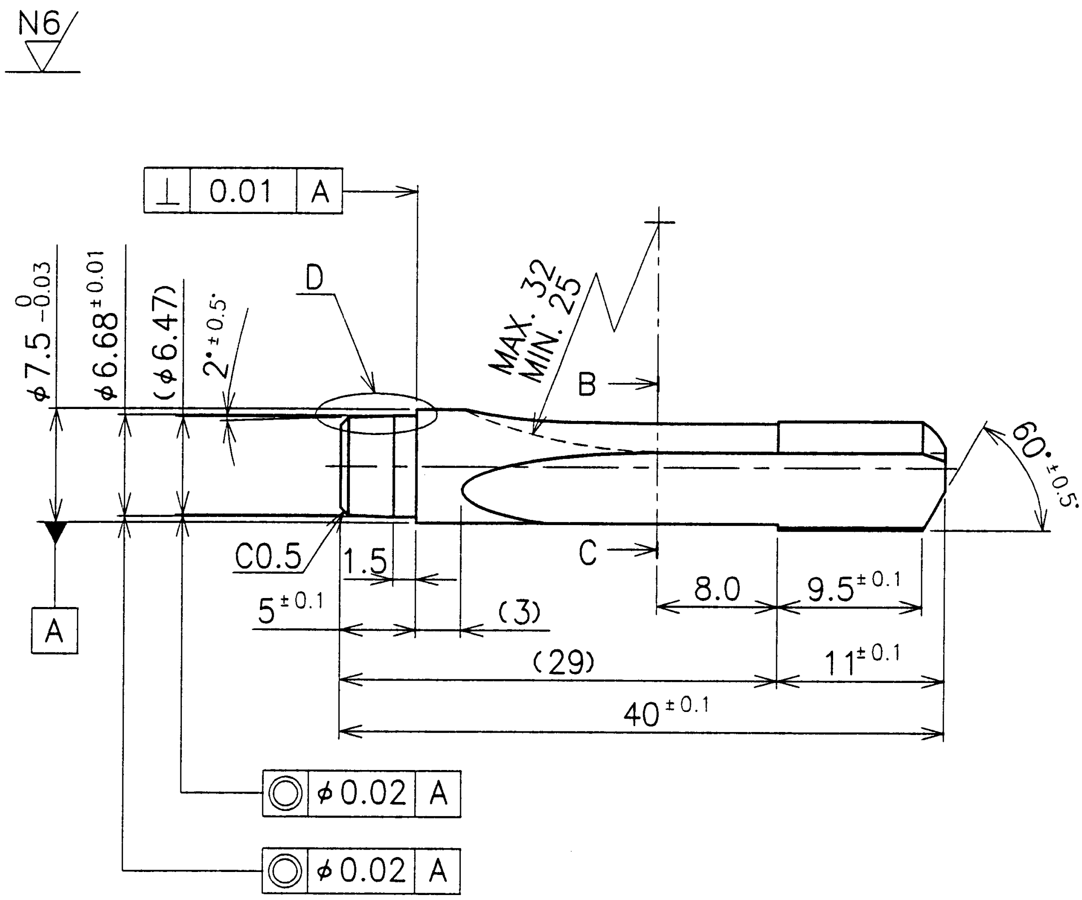
2) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

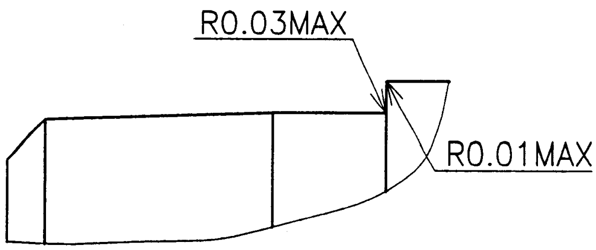
1		UPPER ENDPLUG	PNC1520		
ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS

	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. G[illegible]	1.3.2001	THIRD	UPPER ENDPLUG
DWG.	M. Nagayama	1.3.2001	SCALE	DRAWING NO.
CHECK	H. Nakazawa	5.3.2001	2/1 (10/1)	SPFH0-4PM-01008
APPR.	T. Ake	5.3.2001		

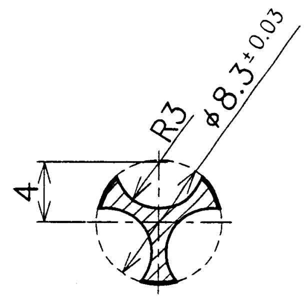
JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE	MARK	CHANGE	NAME	DATE





DETAILED DRAWING D (10/1)



B–C CROSS SECTION

NOTE

1) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.
2) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS
1		LOWER ENDPLUG	PNC1520		

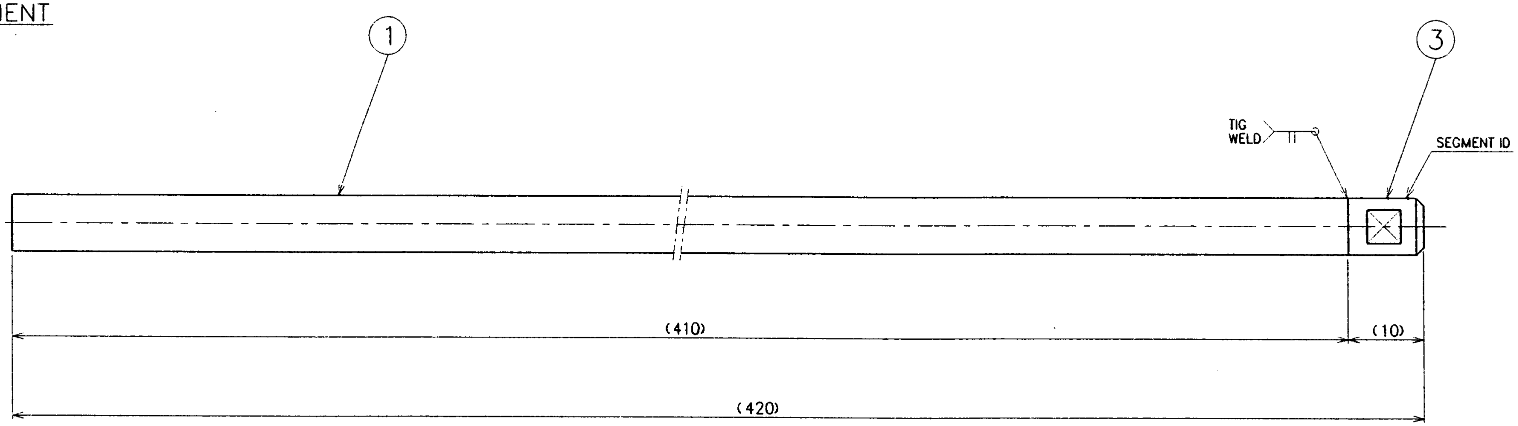
	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. Gaun	1. 3. 2001	THIRD	LOWER ENDPLUG
DWG.	M. Tagayama	1. 3. 2001	SCALE	DRAWING NO.
CHECK	H. Nakazawa	5. 3. 2001	2/1 (10/1)	SPFH0–4PM–01009
APPR.	T. [illegible]	5. 3. 2001		

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

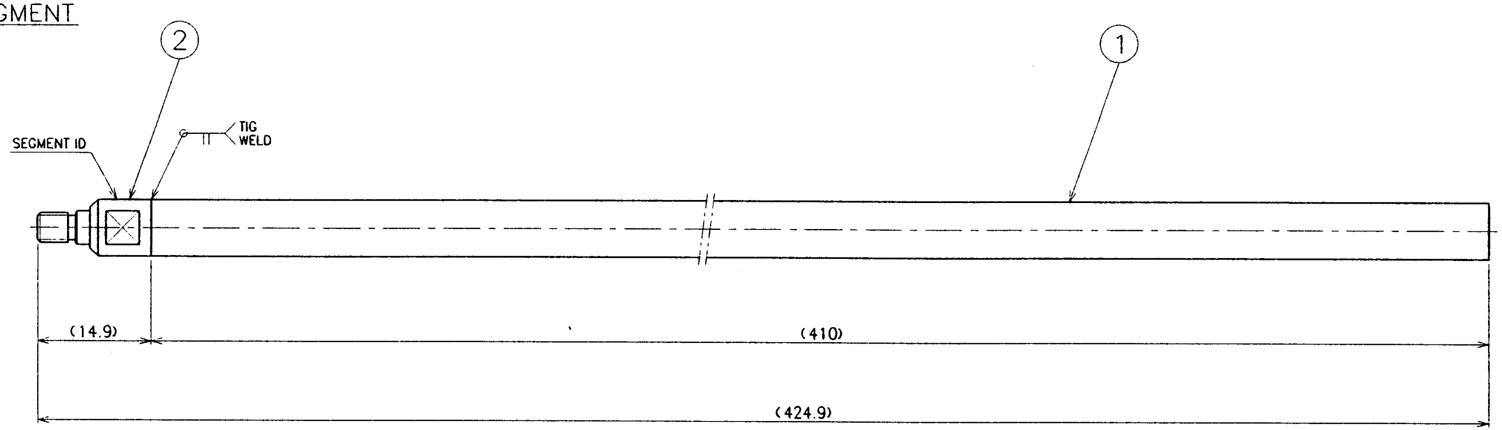
REFERENCE

MARK	CHANGE	NAME	DATE

UPPER FUEL SEGMENT



LOWER FUEL SEGMENT



NOTE

1) BEAD DIAMETER AT THE WELDED JOINT SHOULD BE LESS THAN 7.65MM.
2) THE OVERALL BOWING AFTER CONNECTING SHOULD BE LESS THAN 1.0MM.
3) THERE SHOULD BE NO REMARKABLE COLOURING AND UNDER CUT ON THE WELD ZONE.
4) THERE SHOULD BE NO CRACK, INCLUSION, PINHOLE AND BLOWHOLES EXCEEDING 0.2MM AT THE WELD ZONE.
5) HE LEAK TEST SHOULD BE PERFORMED. HE LEAK RATE SHOULD NOT EXCEED 3×10^{-7} MBAR·L/SEC.
6) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.
7) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUM.	REMARKS
3	01040	LOWER CONNECTION ENDPLUG	PNC1520	1	
2	01039	UPPER CONNECTION ENDPLUG	PNC1520	1	
1	01011	CLADDING	PNC1520	2	

ANGLE		DESIGN	DWG.	CHECK	APPR.
THIRD	NAME	T. Ogawa	M. Nagayama	K. Nakagawa	S. Abe
	DATE	5.9.2001	5.9.2001	12.10.2001	12.10.2001

TITLE SPF IRRADIATION TEST IN HFR

CLADDING WITH CONNECTION ENDPLUG

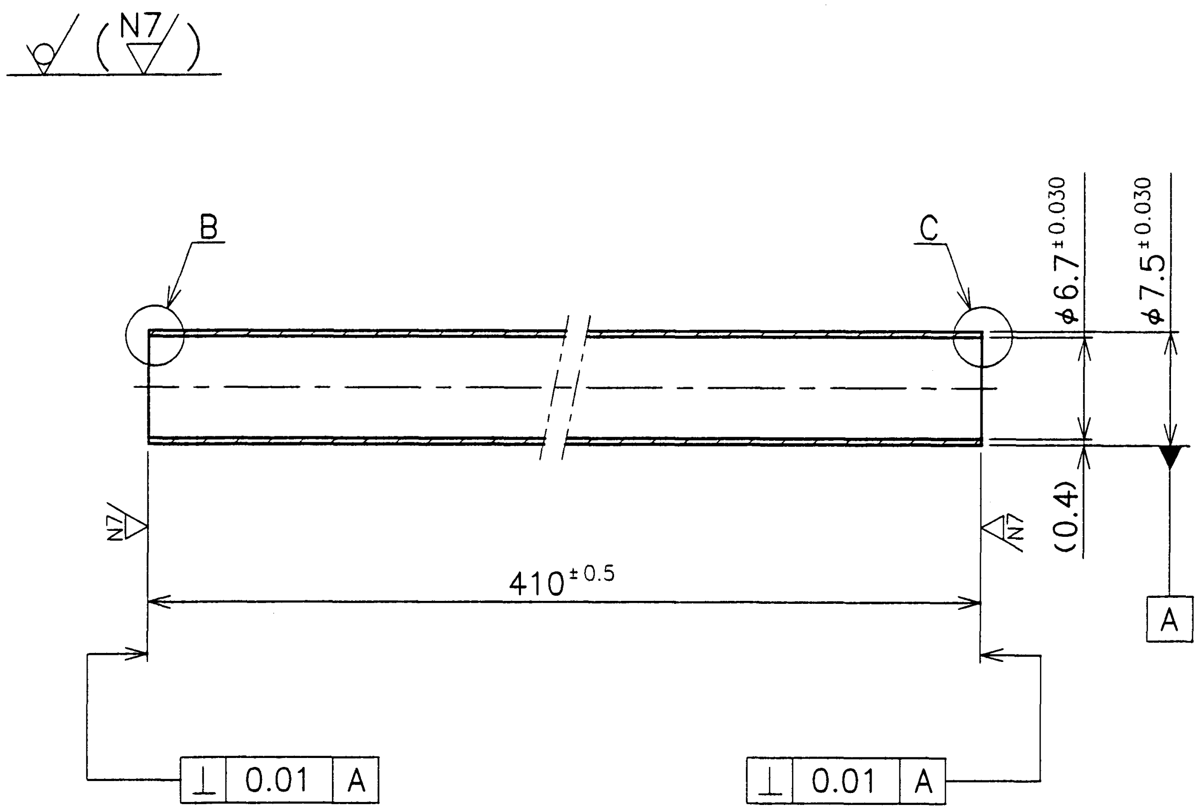
SCALE 2/1 (/)

DRAWING NO. SPFH0-2PM-01038

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE

MARK	CHANGE	NAME	DATE



DETAILED DRAWING B (10/1)

DETAILED DRAWING C (10/1)

NOTE

1) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.

2) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

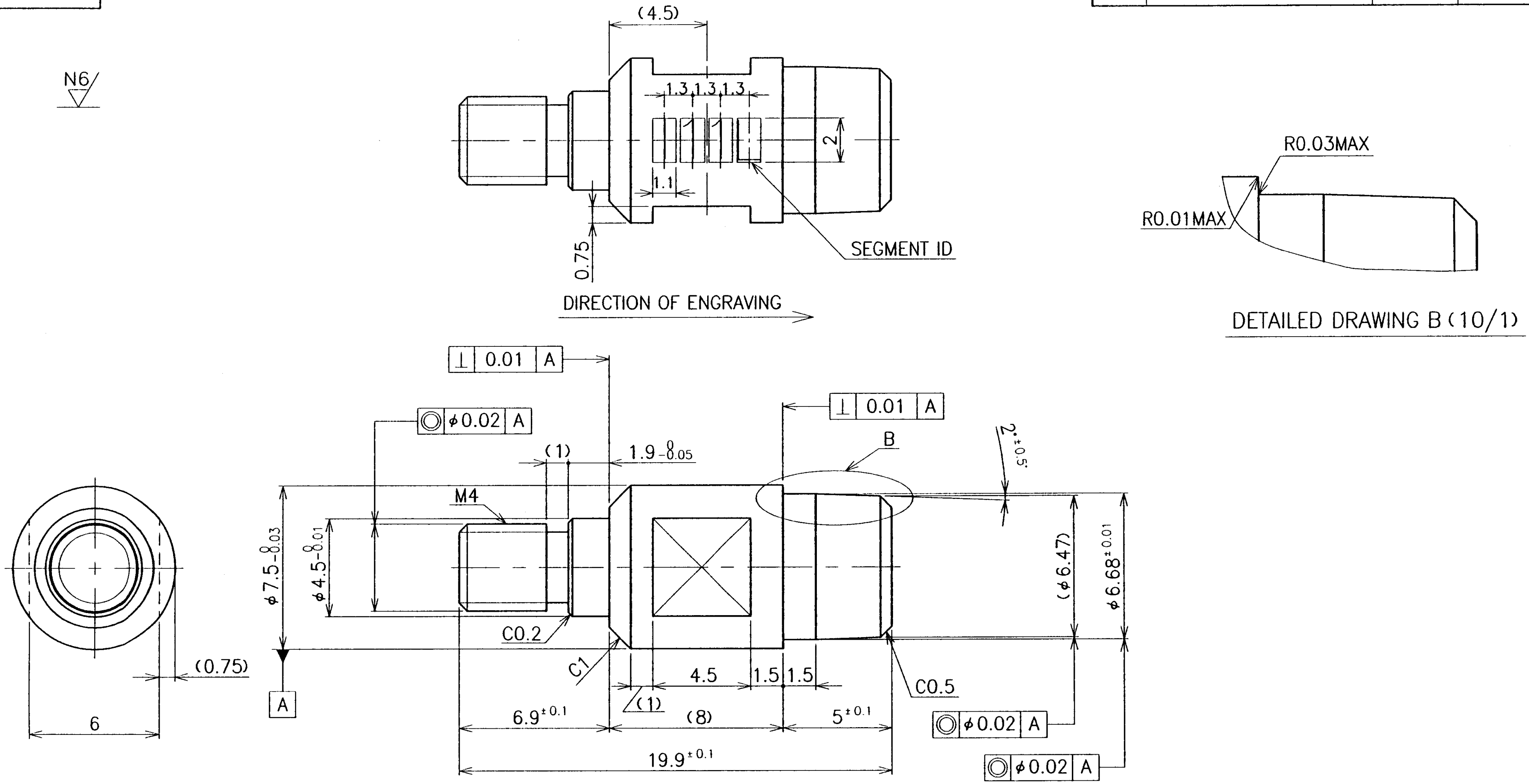
1		CLADDING	PNC1520		
ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS

	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. Gauer	1.3.2001	THIRD	CLADDING
DWG.	N. Nagayama	1.3.2001	SCALE	DRAWING NO.
CHECK	H. Nakazawa	5.3.2001	2/1 (10/1)	SPFH0-4PM-01011
APPR.	T. Abe	5.3.2001		

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE

MARK	CHANGE	NAME	DATE



NOTE

1) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.

2) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUM.	REMARKS
1		UPPER CONNECTION ENDPLUG	PNC1520		

ANGLE		DESIGN	DWG.	CHECK	APPR.
THIRD	NAME	T. Ogawa	M. Nagayama	H. Nakazawa	T. Abe
	DATE	5.9.2001	5.9.2001	12.10.2001	12.10.2001

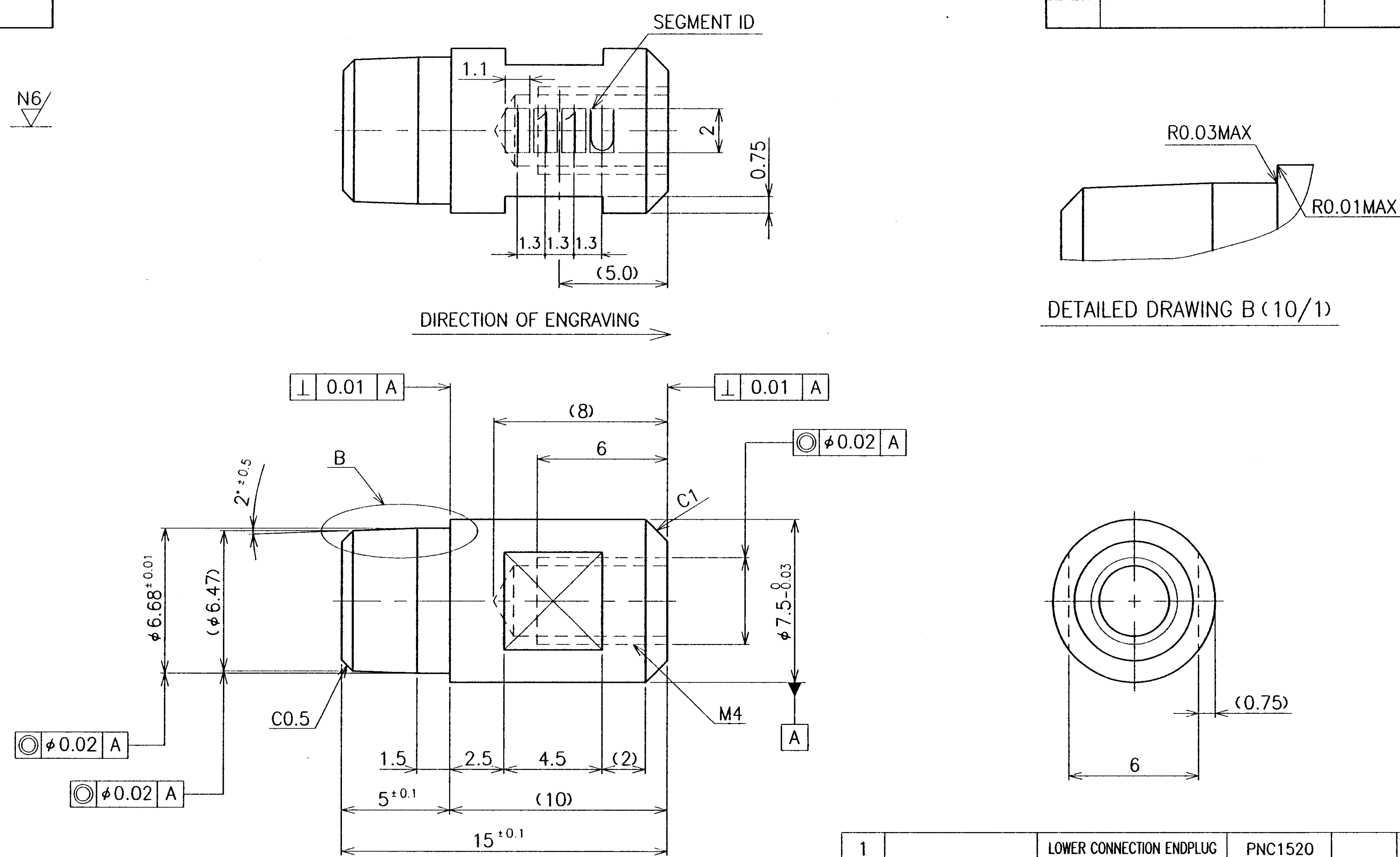
TITLE SPF IRRADIATION TEST IN HFR

SCALE	UPPER CONNECTION ENDPLUG
5/1 (10/1)	DRAWING NO. SPFH0-3PM-01039

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE

MARK	CHANGE	NAME	DATE



1		LOWER CONNECTION ENDPLUG	PNC1520		
ITEM	DRAWING NO.	NAME	MATERIAL	NUM.	REMARKS

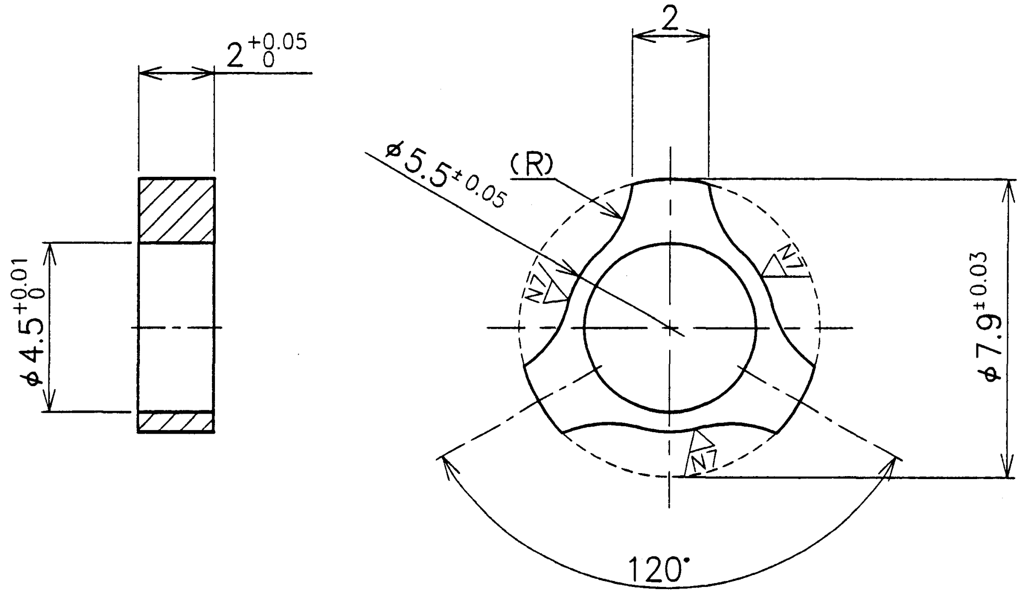
ANGLE		DESIGN	DWG.	CHECK	APPR.
THIRD	NAME	T. Gomi	M. Nagayama	H. Nakazawa	T. Abe
	DATE	5.9.2001	5.9.2001	12.10.2001	12.10.2001
	TITLE SPF IRRADIATION TEST IN HFR				
SCALE	LOWER CONNECTION ENDPLUG				
5/1 (10/1)	DRAWING NO. SPFH0-3PM-01040				

NOTE

1) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.
2) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

REFERENCE	MARK	CHANGE	NAME	DATE

N6 (N7)



NOTE

1) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.

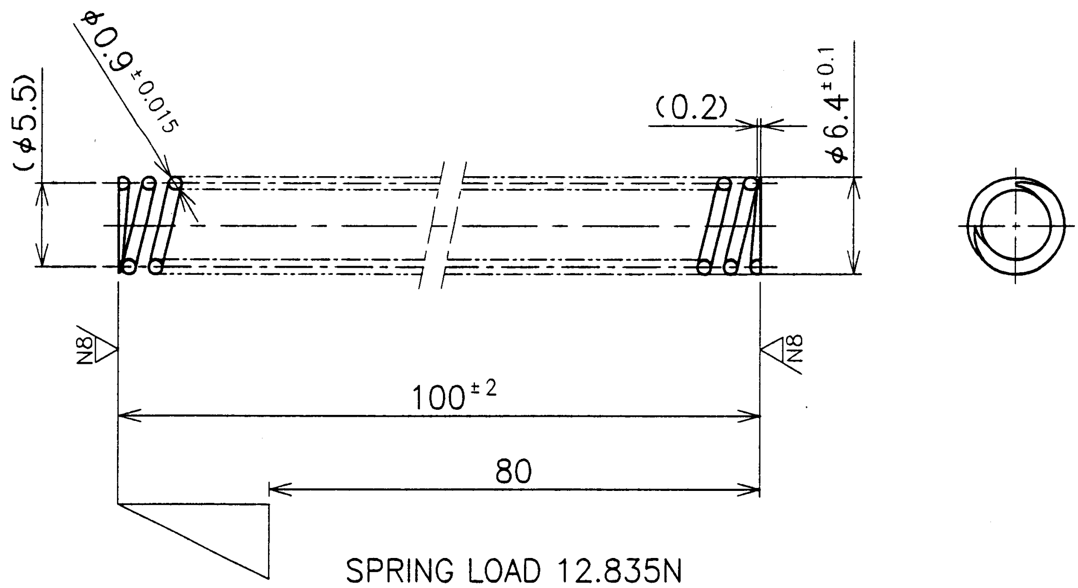
2) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS
1		SPACER	PNC1520		

	NAME	DATE	ANGLE	
DESIGN	T. Ozawa	1.3.2001	THIRD	TITLE SPF IRRADIATION TEST IN HFR SPACER
DWG.	M. Nagayama	1.3.2001	SCALE	DRAWING NO.
CHECK	H. Nakazawa	5.3.2001	5/1 (/)	SPFH0-4PM-01014
APPR.	T. Abe	5.3.2001		

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE	MARK	CHANGE	NAME	DATE



SPRING LOAD 12.835N

PLENUM SPRING SPECIFICATION

MATERIAL		SUS304−WPB
WIRE DIAMETER (mm)		$\phi 0.9^{\pm 0.015}$
COIL OUTER DIAMETER (mm)		$\phi 6.4^{\pm 0.1}$
COIL MEAN DIAMETER (mm)		(ϕ5.5)
EFFECTIVE NUMBER OF TURNS		53
TOTAL NUMBER OF TURNS		55
COIL DIRECTION		CLOCKWISE
FREE LENGTH (mm)		$100^{\pm 2}$
SPRING CONSTANT (N/mm)		$0.642^{\pm 0.042}$
COMMON USE	SPRING LOAD (N)	12.835
	LENGTH (mm)	80

NOTE

1) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.

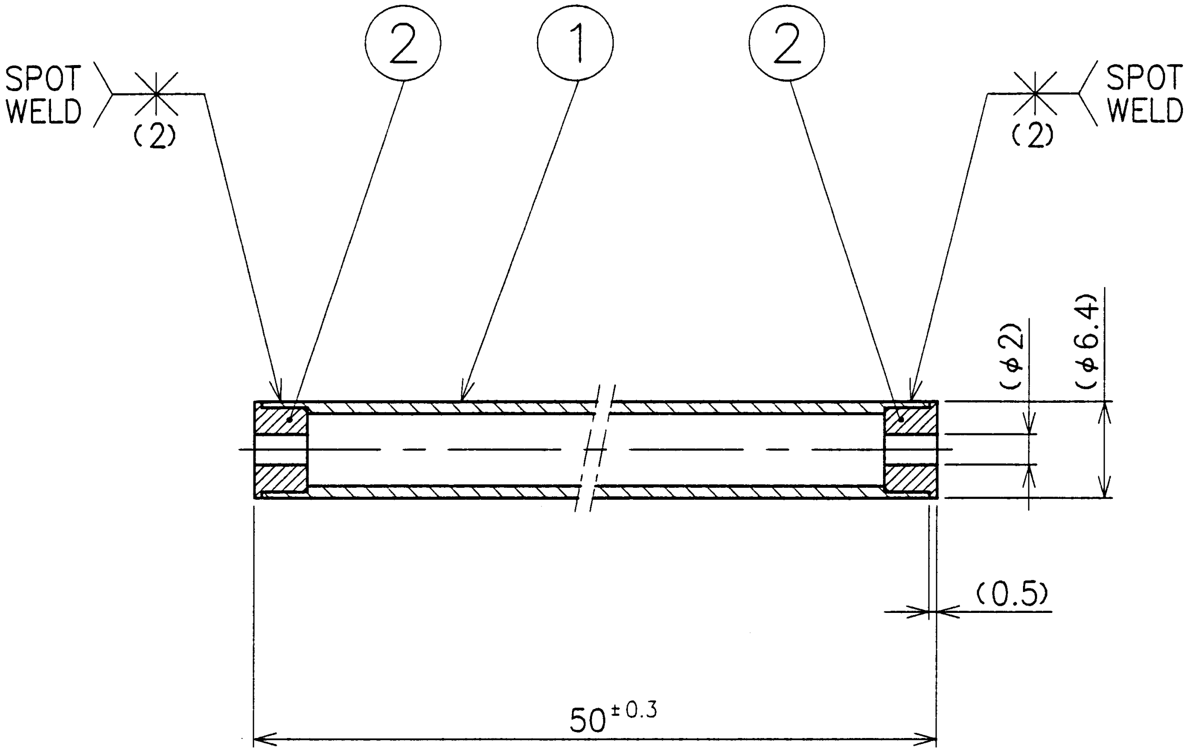
2) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS
1		PLENUM SPRING	SUS304−WPB		

	NAME	DATE	ANGLE	
DESIGN	T. Ganu	1. 3. 2001	THIRD	TITLE SPF IRRADIATION TEST IN HFR PLENUM SPRING
DWG.	M. Nagayama	1. 3. 2001	SCALE	
CHECK	H. Nakazawa	5. 3. 2001	2/1 (/)	DRAWING NO. SPFH0−4PM−01015
APPR.	T. Abe	5. 3. 2001		

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE		MARK	CHANGE	NAME	DATE



NOTE

1) A SLEEVE SHOULD BE PASSED THROUGH THE INSPECTION GAUGE (INNER DIAMETER : $\phi 6.6^{+0.01}_{0}$, LENGTH :20 (MM)).

2) IT SHOULD BE ASSURED THAT A PLENUM SLEEVE COULD BE MOUNTED INTO THE CLADDING.

3) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.

4) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS
2	01017	PLENUM SLEEVE CAP	PNC1520	2	
1	01018	PLENUM SLEEVE TUBE	PNC1520	1	

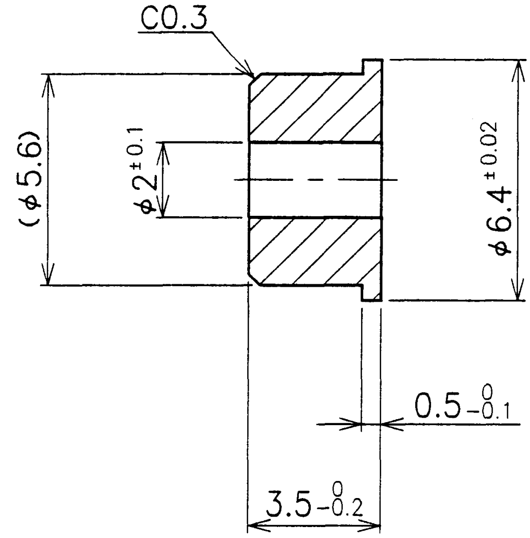
	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. Gawa	1.3.2001	THIRD	PLENUM SLEEVE (PELLET FUEL SEGMENT)
DWG.	M. Nagayama	1.3.2001	SCALE	DRAWING NO.
CHECK	H. Nakagawa	5.3.2001	2/1 (/)	SPFH0-4PM-01016
APPR.	T. Abe	5.3.2001		

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE

MARK	CHANGE	NAME	DATE

N7



NOTE

1) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.

2) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

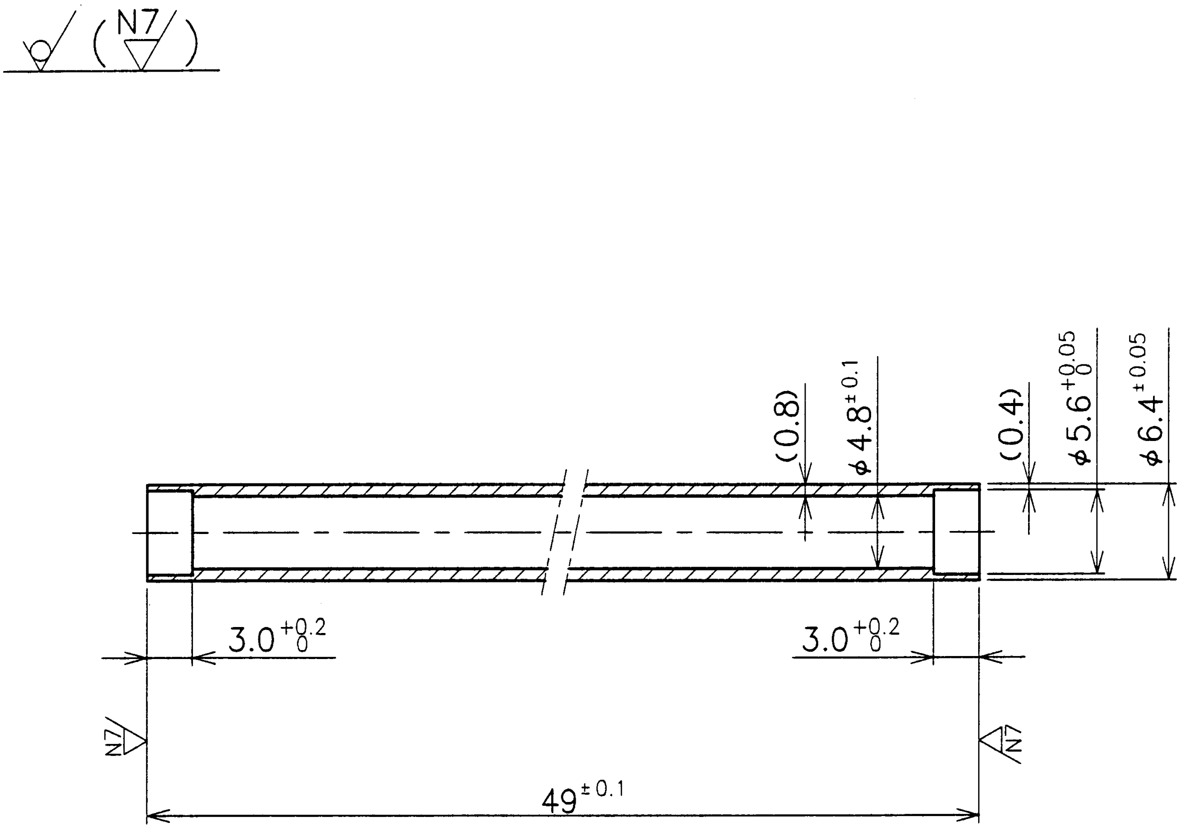
ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS
1		PLENUM SLEEVE CAP	PNC1520		

	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. Ogawa	1.3.2001	THIRD	PLENUM SLEEVE CAP (PELLET FUEL SEGMENT)
DWG.	M. Nagayama	1.3.2001	SCALE	DRAWING NO.
CHECK	K. Nakazawa	5.3.2001	5/1 (/)	SPFH0-4PM-01017
APPR.	T. Abe	5.3.2001		

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE

MARK	CHANGE	NAME	DATE



NOTE

1) THE SLEEVE TUBE SHOULD BE MADE BY MACHINING.
2) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.
3) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

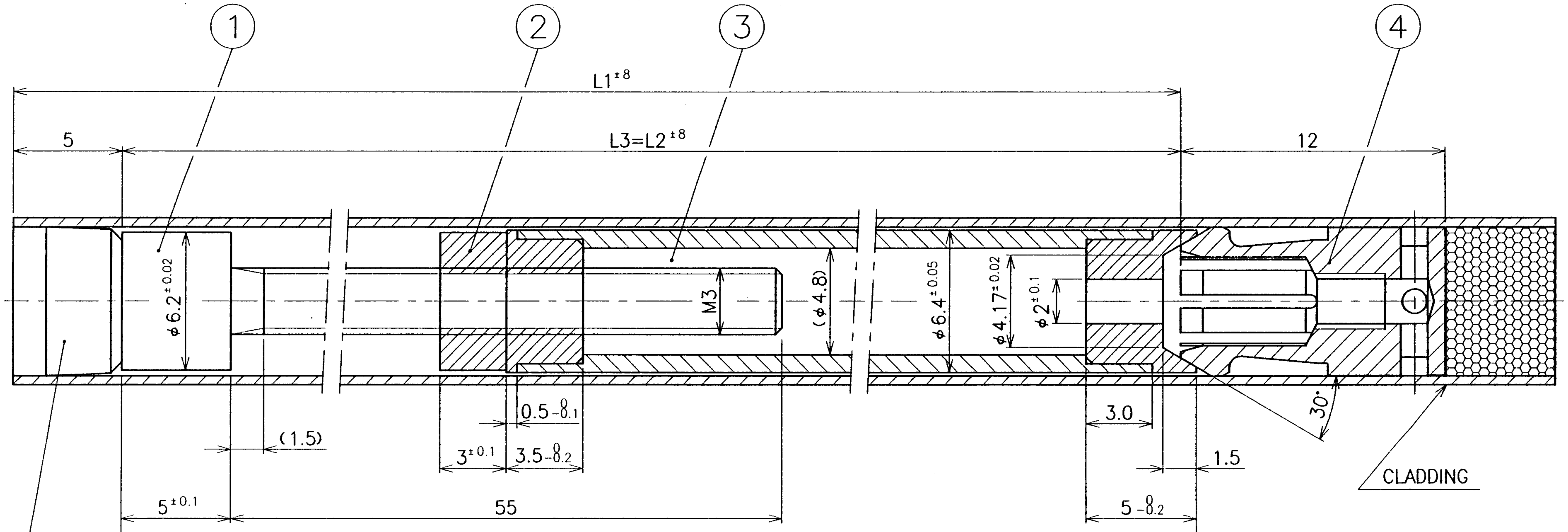
ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS
1		PLENUM SLEEVE TUBE	PNC1520		

	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. Ogawa	1. 3. 2001	THIRD	PLENUM SLEEVE TUBE (PELLET FUEL SEGMENT)
DWG.	N. Nagayama	1. 3. 2001	SCALE	
CHECK	H. Nakazawa	5. 3. 2001	2/1 (/)	DRAWING NO.
APPR.	T. Abe	5. 3. 2001		SPFH0-4PM-01018

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE

MARK	CHANGE	NAME	DATE



L1	123
L2	118

NOTE

1) IT SHOULD ASSURED THAT A SPECIAL PLENUM SLEEVE INCLUDING A DISTANCE SCREW (L4=127) COULD BE MOUNTED INTO THE CLADDING.
2) THE LENGTH L4 SHOULD BE ADJUSTED FOR EACH SEGMENT.
3) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.
4) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

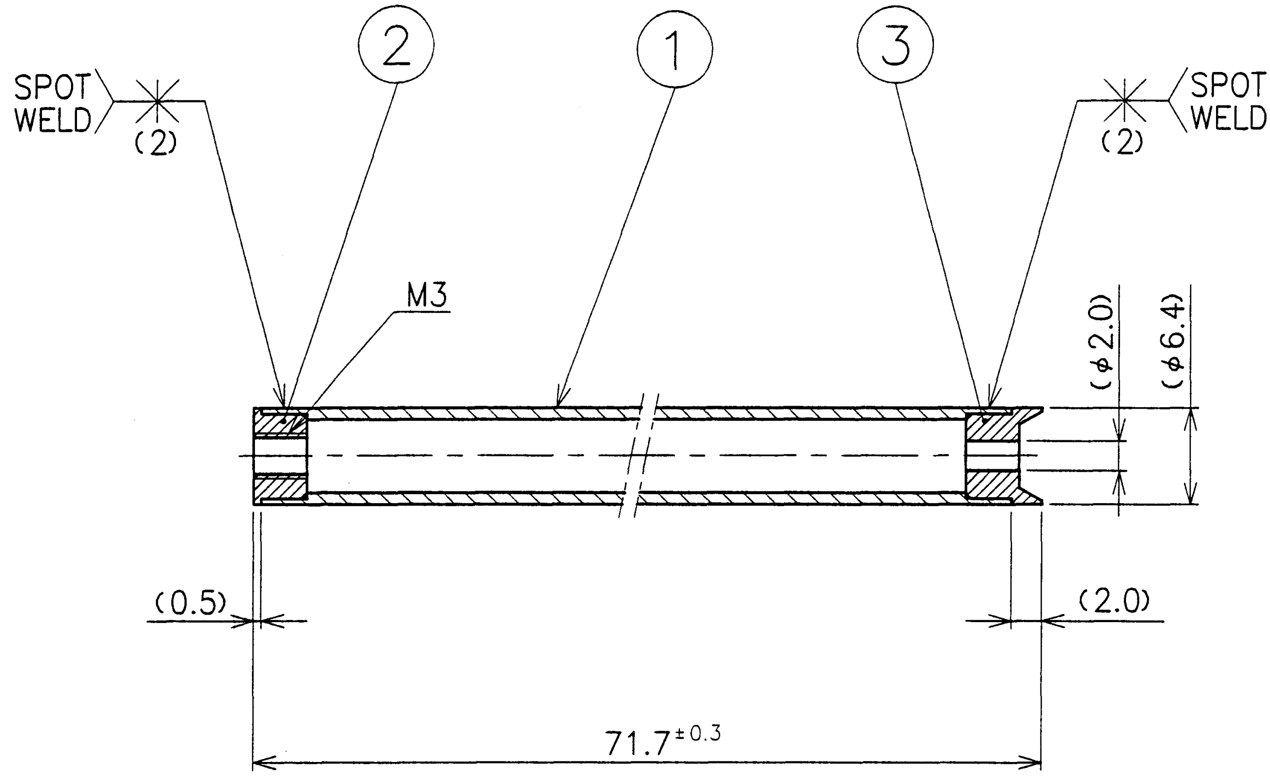
ITEM	DRAWING NO.	NAME	MATERIAL	NUM.	REMARKS
4	01026	PARTICLE RETAINER	PNC1520	1	
3	01020	PLENUM SLEEVE	PNC1520	1	
2	01025	FIXATION NUT	PNC1520	1	
1	01024	DISTANCE SCREW	PNC1520	1	

ANGLE		DESIGN	DWG.	CHECK	APPR.
THIRD	NAME	T. Gauw	M. Nagayama	H. Nakazawa	T. Abe
	DATE	1. 3. 2001	1. 3. 2001	5. 3. 2001	5. 3. 2001
SCALE	TITLE SPF IRRADIATION TEST IN HFR SPECIAL PLENUM SLEEVE (SPHERE-PAC OR VIPAC FUEL SEGMENT)				
5/1	DRAWING NO. SPFH0-3PM-01019				

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE

MARK	CHANGE	NAME	DATE



NOTE

1) A SLEEVE SHOULD BE PASSED THROUGH THE INSPECTION GAUGE (INNER DIAMETER : $\phi 6.6^{+0.01}_{0}$, LENGTH : 20 (MM)) .

2) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.

3) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

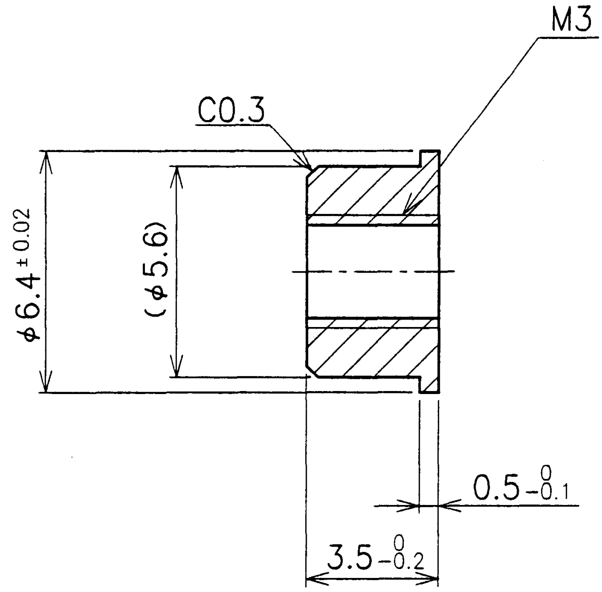
3	01022	PLENUM SLEEVE CAP (2)	PNC1520	1	
2	01021	PLENUM SLEEVE CAP (1)	PNC1520	1	
1	01023	PLENUM SLEEVE TUBE	PNC1520	1	
ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS

	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. Ogawa	1.3.2001	THIRD	PLENUM SLEEVE (SPHERE-PAC OR VIPAC FUEL SEGMENT)
DWG.	M. Nagayama	1.3.2001	SCALE	
CHECK	H. Nakazawa	5.3.2001	2/1 (/)	DRAWING NO.
APPR.	T. Abe	5.3.2001		SPFH0-4PM-01020

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE	MARK	CHANGE	NAME	DATE

N7



NOTE

1) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.

2) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS
1		PLENUM SLEEVE CAP (1)	PNC1520		

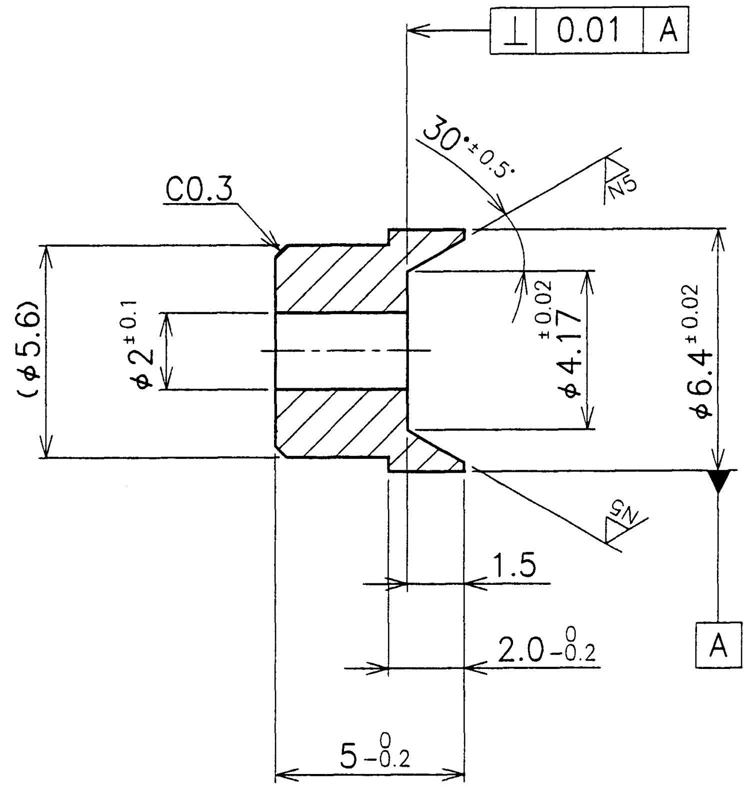
	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. [illegible]	1. 3. 2001	THIRD	PLENUM SLEEVE CAP (1) (SPHERE-PAC OR VIPAC FUEL SEGMENT)
DWG.	N. Nagayama	1. 3. 2001	SCALE	
CHECK	H. Nakazawa	5. 3. 2001	5/1 (/)	DRAWING NO. SPFH0-4PM-01021
APPR.	[illegible]	5. 3. 2001		

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE

MARK	CHANGE	NAME	DATE

N7 (N5)



NOTE

1) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.

2) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

1		PLENUM SLEEVE CAP (2)	PNC1520		
ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS

	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. Ogawa	1.3.2001	THIRD	PLENUM SLEEVE CAP (2) (SPHERE-PAC OR VIPAC FUEL SEGMENT)
DWG.	M. Nagoyama	1.3.2001	SCALE	
CHECK	H. Nakagawa	5.3.2001		DRAWING NO.
APPR.	T. Abe	5.3.2001	5/1 (/)	SPFH0-4PM-01022

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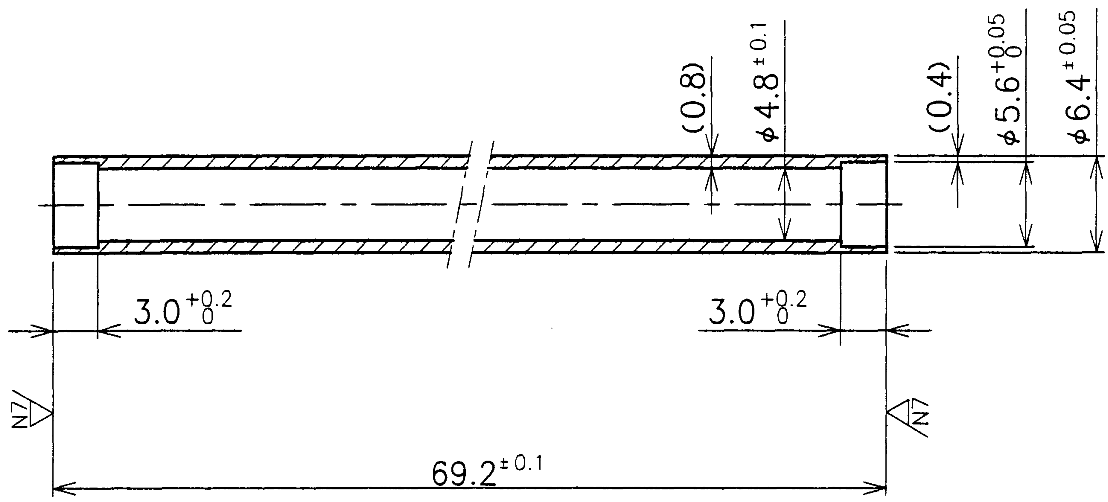
REFERENCE

MARK	CHANGE	NAME	DATE

(N7)



NOTE

1) THE SLEEVE TUBE SHOULD BE MADE BY MACHINING.

2) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.

3) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

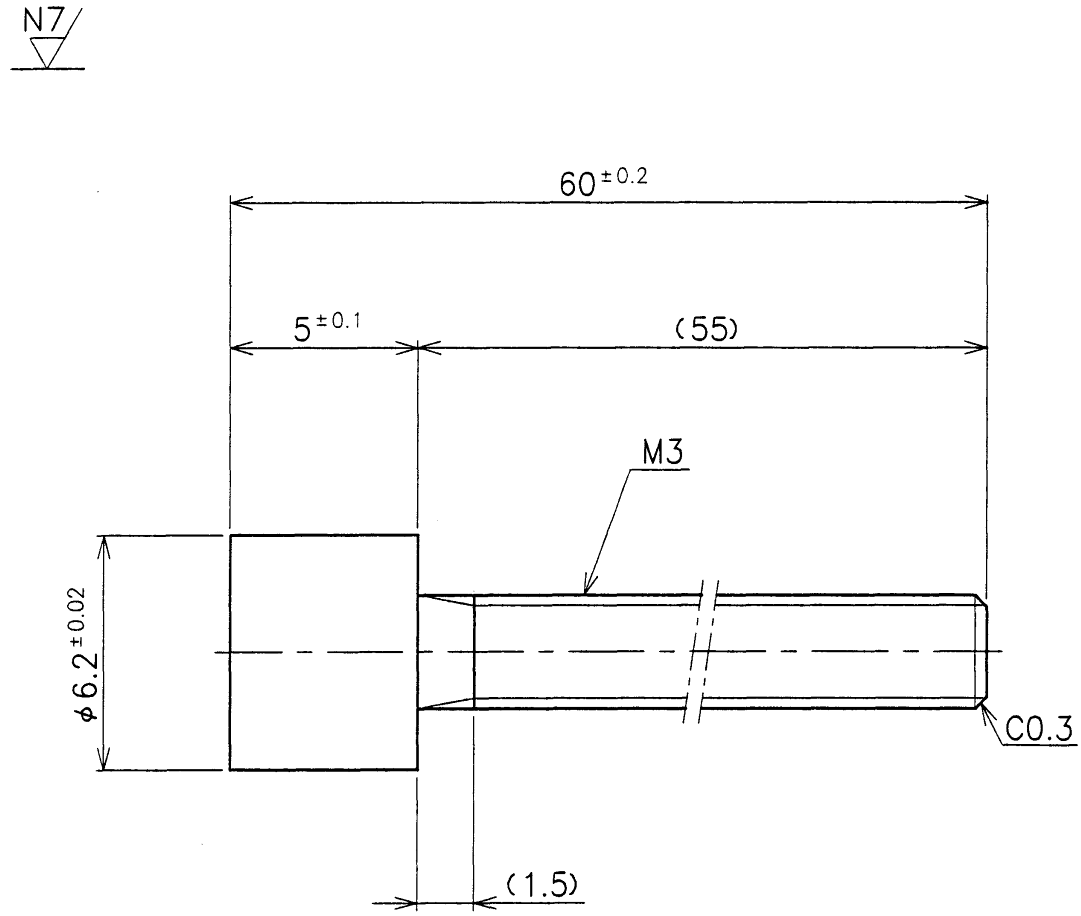
ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS
1		PLENUM SLEEVE TUBE	PNC1520		

	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. Gouma	1.3.2001	THIRD	PLENUM SLEEVE TUBE (SPHERE-PAC OR VIPAC FUEL SEGMENT)
DWG.	M. Nagayama	1.3.2001	SCALE	
CHECK	H. Nakazawa	5.3.2001	2/1 (/)	DRAWING NO. SPFH0-4PM-01023
APPR.	T. Abe	5.3.2001		

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE

MARK	CHANGE	NAME	DATE



NOTE

1) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.

2) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS
1		DISTANCE SCREW	PNC1520		

	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. Ogawa	1.3.2001	THIRD	DISTANCE SCREW (SPHERE-PAC OR VIPAC FUEL SEGMENT)
DWG.	M. Nagayama	1.3.2001	SCALE	
CHECK	H. Nakazawa	5.3.2001	5/1 (/)	DRAWING NO. SPFH0-4PM-01024
APPR.	T. Abe	5.3.2001		

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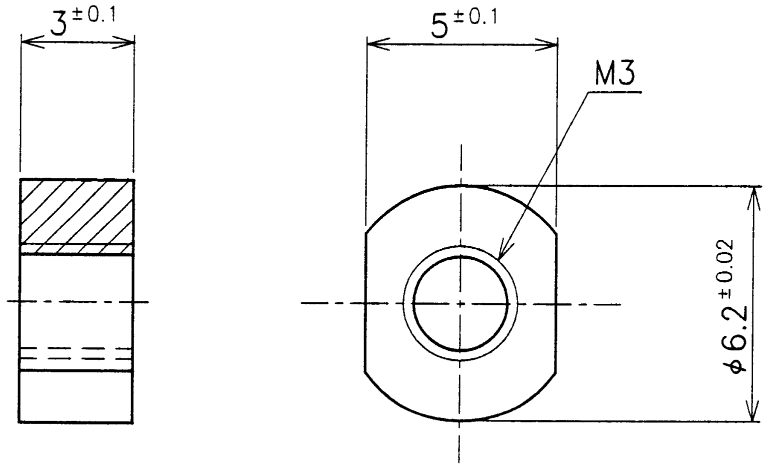
REFERENCE

MARK	CHANGE	NAME	DATE

N7



NOTE

1) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.
2) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS
1		FIXATION NUT	PNC1520		

	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. Ozawa	1.3.2001	THIRD	FIXATION NUT (SPHERE-PAC OR VIPAC FUEL SEGMENT)
DWG.	M. Nagayama	1.3.2001	SCALE	
CHECK	H. Nakazawa	5.3.2001		DRAWING NO.
APPR.	T. Abe	5.3.2001	5/1 (/)	SPFH0-4PM-01025

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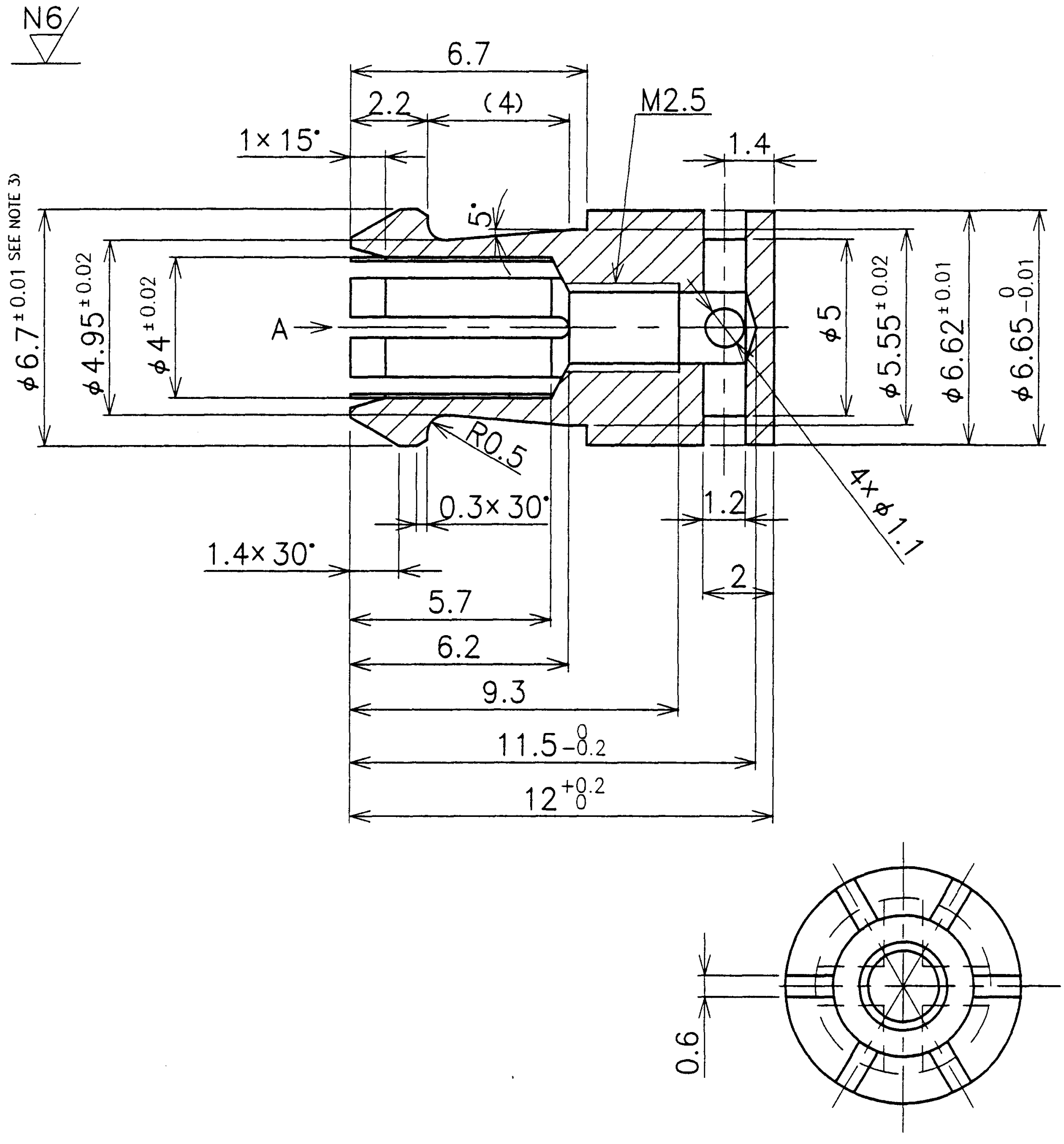
REFERENCE	MARK	CHANGE	NAME	DATE



VIEW A

NOTES

1) EDGES CHAMFERED 0.1×45° .

2) SLITS TO BE ELECTRO-ERODED AFTER TURNING.

3) DIAMETER 6.7 TO BE EXPANDED TO ϕ6.9±0.03MM BY SPREADING.

4) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.

5) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

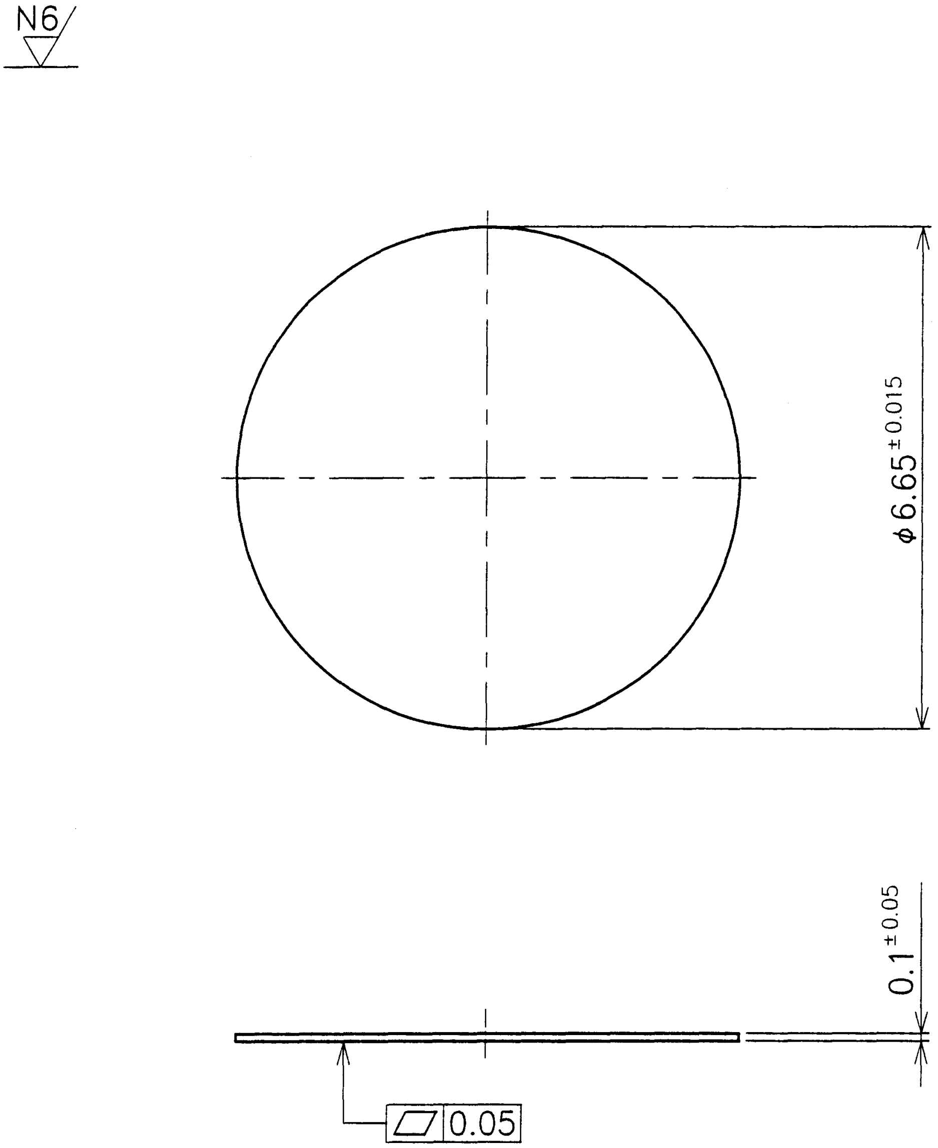
ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS
1		PARTICLE REATAINER	PNC1520		

	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. Gawa	1.3.2001	THIRD	PARTICLE RETAINER (SPHERE-PAC OR VIPAC FUEL SEGMENT)
DWG.	M. Nagayama	1.3.2001	SCALE	
CHECK	H. Nakazawa	5.3.2001		DRAWING NO.
APPR.	T. Abe	5.3.2001	5/1 (/)	SPFH0-4PM-01026

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE

MARK	CHANGE	NAME	DATE



NOTE

1) THERE SHOULD BE NO HARMFUL CRACK, FLAW ETC. ON THE SURFACE.

2) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

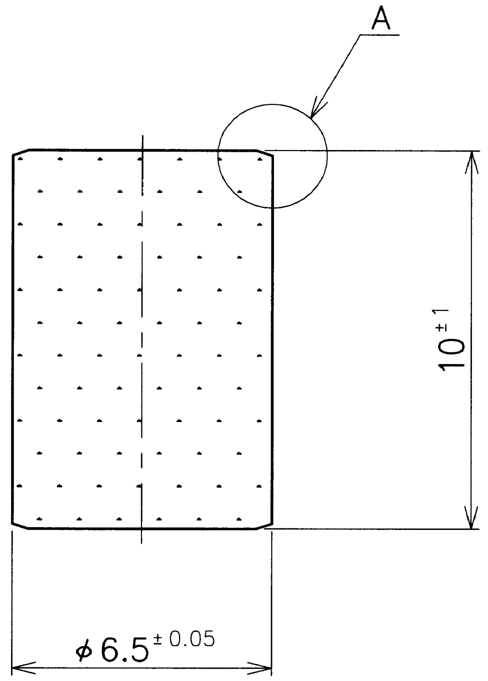
1		FUEL SEAL DISC	W		PURITY:99.95%
ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS

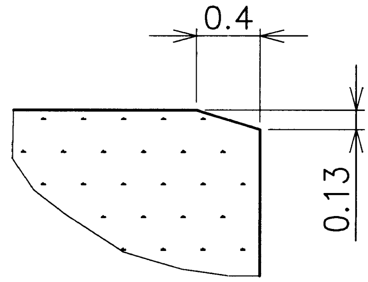
	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. Gou	1.3.2001	THIRD	FUEL SEAL DISC (SPHERE-PAC OR VIPAC FUEL SEGMENT)
DWG.	M. Nagayama	1.3.2001	SCALE	
CHECK	H. Nakazawa	5.3.2001	10/1 (/)	DRAWING NO. SPFH0-4PM-01027
APPR.	T. Abe	5.3.2001		

JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE

MARK	CHANGE	NAME	DATE





DETAILED DRAWING A (20/1)

Pu CONTENT (wt%)	DENSITY (%T.D.)	O/M RATIO
20	$95^{\pm 2}$	$1.97^{+0.02}_{-0.03}$

NOTE

1) THE TARGET O/M RATIO SHOULD BE 1.97.
2) THERE SHOULD BE NO HARMFUL CHIP, CRACK, FLAW ETC. ON THE SURFACE.
3) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

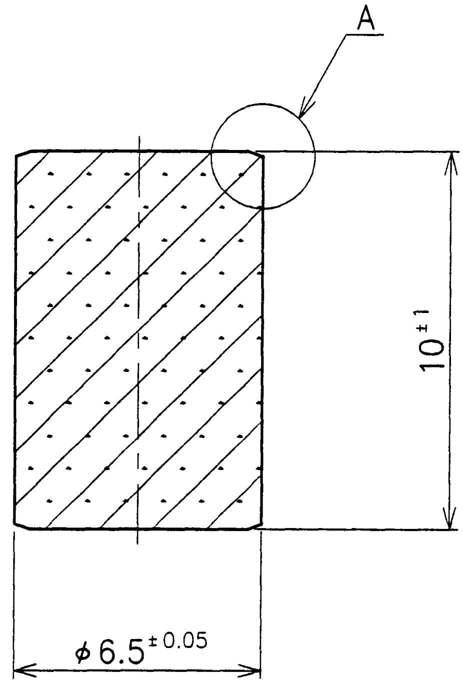
1		MOX FUEL PELLET	PuO_2-UO_2		
ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS

	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. Gawa	17.1.2002	THIRD	MOX FUEL PELLET
DWG.	M. Nagayama	17.1.2002	SCALE	DRAWING NO.
CHECK	H. Nakazawa	21.1.2002	5/1 (20/1)	SPFH0-4PM-02009
APPR.	T. Abe	21.1.2002		

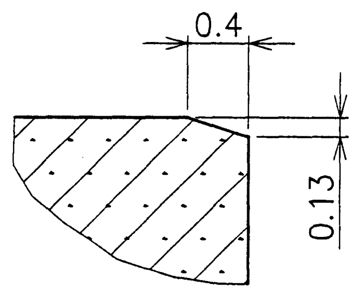
JAPAN NUCLEAR CYCLE DEVELOPMENT INSTITUTE.TOKAI WORKS

REFERENCE

MARK	CHANGE	NAME	DATE



DENSITY (%T.D.)	O/U RATIO
$95^{\pm 2}$	2.00~2.02



DETAILED DRAWING A (20/1)

NOTE

1) THERE SHOULD BE NO HARMFUL CHIP, CRACK, FLAW ETC. ON THE SURFACE.

2) THERE SHOULD BE NO HARMFUL STICKINESS (OILS AND FATS, OXIDE ETC.) ON THE SURFACE.

ITEM	DRAWING NO.	NAME	MATERIAL	NUMBERS	REMARKS
1		THERMAL INSULATOR PELLET	DEPLETED UO_2		

	NAME	DATE	ANGLE	TITLE SPF IRRADIATION TEST IN HFR
DESIGN	T. Ogawa	1. 3. 2001	THIRD	THERMAL INSULATOR PELLET
DWG.	N. Nagayama	1. 3. 2001	SCALE	
CHECK	H. Nakazawa	5. 3. 2001		DRAWING NO.
APPR.	T. Ohe	5. 3. 2001	5/1 (20/1)	SPFH0-4PM-01029

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