Core Component Pot

Copy no.____

Fast Flux Test Facility
System Design
Description No. 41 Part 9

Hanford Engineering Development Laboratory

Prepared by

WESTINGHOUSE HANFORD COMPANY
P.O. BOX 1970
RICHLAND, WASHINGTON 99352

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A.M. Stelle	713	LA09
G. Landler	731	LB30

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*	NAME	MAIL ADDR
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A. M. Stelle	713	LA09

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	W.R. Vaughn	LA08
	R.H. Gutzmann	LA37
	A. M. Stelle (10)	LA09

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ABSTRACT

Core Component Pot Design Data

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FFTF
SYSTEM DESIGN DESCRIPTION
FOR
CORE COMPONENT POT
SDD 41, PART 9

ABSTRACT

The core component pot is an open top vessel used to hold both new and irradiated core components for storage in the IDS and for holding the components submerged in sodium while being transported inside CLEM. The top of the CCP is equipped with a grapple lip which is engaged by the hoisting grapples. Heat for maintaining the preheat of new components and the dissipation of decay heat of irradiated fuel assemblies is conducted between the wall of the pot and the surrounding environment by thermal radiation and convection.

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1.0 FUNCTIONS AND REQUIREMENTS

1.1 FUNCTIONS

1.1.1 Containment

Core Component Pots are used to keep core components submerged in liquid sodium during residence in plant equipment and facilities, during transfer between those locations, and during other handling operations.

1.1.2 Heat Transfer

The CCP's serve as heat transfer surfaces for rejection of the contained component decay heat to the bulk coolant in the reactor and IDS and to the CLEM cold wall while in the CLEM.

1.2 DESIGN REQUIREMENTS

The Core Component Pots have the following requirements and considerations which are imposed by the functions defined in Paragraph 1.1.

1.2.1 Process

The CCP's must contain liquid sodium and the core components listed in Table I, and accommodate the grapples listed in Table II. The components, CCP, and grapples have a random azimuthal orientation.

TABLE I

COMPONENTS CONTAINED BY CCP

1. Driver fuel assemblies
2. Reflectors, inner and outer
3. Shim, scram, and control assemblies
4. Shortened open test assemblies
5. Core restraint bars
6. Pedestals

TABLE II

GRAPPLES ACCOMMODATED BY CCP

1. BLTC grapple
2. IVHM grapple
3. CCP grapple on the IEM cell crane
4. CLEM grapple

Items 1, 2, and 3 of Table I engage and release core components. Item 6 of Table I shall be used for all short components to keep the proper height for pickup by the grapples used in handling. Items 3 and 4 of Table II engage and release core component pots.

The CCP's must have an opening and internal grapple engagement rim at the top of sufficient size to pass the components and the grapples used in the handling operations. The CCP resides in the resident locations listed in Table III. The size of the CCP's is limited by the space provided in the facilities and core components and test assemblies listed in Table III. The CCP's have a random azimuthal orientation to the facilities.

TABLE III

RESIDENT LOCATIONS

1.	IDS – Core component storage tubes (112 places)
2.	CCCS – Conditioning cell and transfer cell (1 place each)
3.	Reactor vessel – Core support structure (3 places) only when reactor is shut down
4.	CLEM – Cold wall (1 place)
5.	IEM cell – Core component conditioning container (1 place) and core component pot storage containers (2 places)

The CCP's pass through the equipment listed in Table IV during their movement in the refueling cycle.

TABLE IV

EQUIPMENT PASSAGES

1.	Floor valve
2.	IDS ports
3.	Reactor fuel transfer ports
4.	IEM cell ports and fixtures
5.	CLEM closure valve
6.	CLEM drip pan port
7.	CLEM viewing port
8.	CLEM cold wall
9.	CCCS ports

1.2.2 Mechanical

The CCP is capable of withstanding stresses resulting in mechanical loadings shown in Table V under operating conditions defined in Paragraph 4.0. Refer to Appendix C, Items 2.5, 2.8, 2.9, and 2.10.

TABLE V

MECHANICAL LOADINGS

1. Pressure loads
   a. Internal pressure due to hydrostatic head of sodium
   b. Internal pressure due to dynamic head caused by acceleration
   c. External pressure due to hydrostatic head of sodium
   d. External pressure due to hydrodynamic head caused by dash pot effect in facility tubes
2. Weights
   a. CCP
   b. Sodium fill
   c. Core component
3. Push and pull loads by CLEM grapple and IEM Cell CCP Grapple
4. Transverse impact loads caused by hitting the CLEM cold wall during CLEM transporter acceleration or by earthquake
5. Axial impact loads caused by
   a. Arrest of CCP vertical velocity by facilities or grapples
   b. Arrest of grapple vertical velocity by CCP

1.2.3 Thermal

The CCP will withstand the stresses resulting from the thermal conditions shown in Table VI. Refer to Appendix C, Items 1.4.4, 2.5, 4.2.1, and 4.3.1.

TABLE VI
THERMAL LOADINGS

1.	Thermal transients resulting from the mechanical transfer through the temperature difference between allowable maximum temperature in CLEM and the reactor or IDS sodium temperature.
2.	Axial temperature differences due to the afterglow heat distribution of the irradiated fuel elements.
3.	Maximum temperatures due to changes and uncertainties in the emissivity of the CCP wall and thermal syphon circulation of sodium through the fuel assembly.

1.2.4 Safety

Spilling sodium from the top of the CCP's follows a pattern which will not have deleterious effects on the facility or equipment. No provision is required to protect the integrity of the pot for containment of molten fuel.

1.2.5 Design Life

The CCP has a minimum service life of 10 years.

The design requires that the CCP shall not rupture or leak when subjected to:

a. 27 normal transfers or upset conditions

b. Emergency and faulted conditions require the CCP to be removed and examined for structural integrity.

Furthermore, two emergency conditions shall be considered to constitute a faulted condition.

1.2.6 Maintenance

No maintenance is required for the CCP's while in service. Damaged CCP's will be replaced. Damage is defined as any deformation which would impair the reliable functional capability of the CCP.

1.2.7 Instrumentation and Control

No instrumentation is provided to monitor or control conditions of the CCP's. Data is obtained from the CCP resident locations by other equipment.

1.2.8 Interface

The CCP's shall be designed to interface with the following items:

1) Core components to be handled (see Table I)

2) Facilities to be contained in and pass through (see Tables II and IV)

3) Grapples to be accommodated (see Table III).

Both irradiated and new core components will freely fit into the CCP without being forced.

1.2.9 Quality Assurance

In addition to the inspection and testing requirements of the ASME Boiler and Pressure Vessel Code, Section III Nuclear Power Plant Components, 1971 Edition, a helium leak test shall be conducted on the CCP. The leakage shall not exceed 10^{-7} cc/sec (STP). For a quality assurance program, the requirements of RDT Standard F 2-2T and F 2-4T shall apply.

1.2.10 Codes and Standards

The Core Component Pot will be constructed to comply with the requirements for Class I components set forth in Section III of the ASME Boiler and Pressure Vessel Code, as supplemented by Code Case 1331-5 for high temperature service. Provisions of RDT Standard E 15-2T apply for non-destructive testing and selection of materials. Code stamping is not required. The code requirements relative to the functions of an "Authorized Inspector" or "Authorized Inspection Agency" shall be met by an inspection agency designated by the owner.

3. Other Exceptions

(a) The design rules of Code Case 1331-5 do not apply; however, the allowable stress values given in 1331-5 shall be used.

4. Certified Design Specifications

Code requirements that Design Specifications be certified to comply with all the rules of the code do not apply. The design specification will be certified to be in compliance with all code requirements except those modified by 1, 2 and 3 above.

5. Certified Stress Report

Code requirements that the stress report be certified to comply with the rules of the Code do not apply. The stress report will be certified to be in compliance with the design specification and all Code requirements except those modified by 1, 2, 3 and 4 above.

6. The Manufacturer's Data Report

All Code requirements for data reporting except those modified by 1, 2, 3, 4 and 5 above shall be met.

1.2.11 Materials

The CCP is minimum 0.04 carbon content austenitic stainless steel to be compatible with the high temperature liquid sodium. The external surfaces of the body of the CCP's for 10 kw or greater

are provided with a high thermal radiation emissivity coating to enhance heat rejection in CLEM.

1.2.12 Fabrication

The CCP shall be welded. Welds joining the CCP body to the cap and top shall be volumetrically examined by radiographic nondestructive methods in accordance with the procedures and acceptance criteria of RDT E 15-2T. The CCP shall be fabricated in accordance with Drawing H-4-26127 (see Appendix C).

All surfaces shall be free of crevices which may be susceptible to sodium oxide deposits. Cleaning and maintaining of cleanness shall comply with the applicable provisions of RDT Standard F 5-1T.

1.2.13 Inservice Inspection

Inservice inspection of CCP's consists of viewing the CCP through CLEM viewing port, confirming in the IEM Cell that the CCP meets straightness requirements, and visual examination of the CCP in the IEM cell.

1.2.14 Identification

The CCP's must be clearly marked to permit identification of each pot when viewed through the CLEM viewing port and in the IEM Cell.

2.0 DESCRIPTION

2.1 SUMMARY DESCRIPTION

The core component pot is an open top, welded vessel consisting of a tubular body, a bottom closure cap, and a top piece with a rim shaped for engagement with the CLEM and CCP grapples. It will accommodate a maximum of 0.9-in. bow in a standard cross-section core component.

2.2 DETAILED DESCRIPTION

2.2.1 Body

The CCP body is a 6-in. nominal size Schedule 10 pipe ~130 in. long. These dimensions assure accommodation of the core component fully submerged in sodium inside the CCP, also accommodation of the CCP in the facilities and handling equipment. The 0.134-in. wall thickness will withstand mechanical loads and thermal loads as defined in Tables V and VI, respectively. The critical loads are summarized in Table VII. The external surface with a high thermal radiation emissivity coating is adequate to assure rejection of the fuel element afterglow heat.

Core Component Pots containing assemblies in the nominal 6-10 kWt range will require a high emissivity coating on the body. Administrative control will be required to assure the correct CCP is used.

TABLE VII

CRITICAL LOADING CONDITIONS

Load Type	Loading Description	Location	Applied Stress	Allowable Stress
Design	Forces of 5000 lb tension	Ring/pipe interface	15.4 ksi	17.7 ksi
Norm/upset	Removal force of 4 g's applied during immersion of CCP into IDS vessel (920° F)	CCP Center	23.64	17.86†
Emergency	CLEM grapple push and 3/4 in. free fall of CCP onto grapple fingers	Ring/pipe inter-section	24.0 ksi	26.1 ksi
Faulted	Evaluation not complete. Preliminary results indicate maximum stress condition of CCP striking support structure at 600 ft/min as structurally acceptable.			

†Stressed over elastic allowable for high temperature application. Structurally acceptable per Core Case 1331-5 in that:

1) Creep - negligible
2) Fatigue - 30 cycle min (design life 6)
3) Thermal ratcheting - none
4) Strain limited (thermally induced)

2.2.2 Cap

The closure cap at the bottom of the CCP is a forging. It will structurally resist mechanical and thermal loads as defined in Tables V and VI, respectively. The critical load condition is Item 5a of Table V. The magnitude of the load is shown in Table VII. The outside diameter and the shape of the external surface are determined

to assure centering of the CCP when entering a facility storage position and to minimize self-welding during storage.

The outside diameter is larger than the body to minimize the ovality and straightness requirements of the body and facility support tube. The tolerance is restrictive to allow the facility to use the cap as a plunger in any dash pot velocity arrest system.

2.2.3 Top

The top piece of the CCP is machined from a forging to have a continuous circular lip at the upper end reaching inward for engagement with the grapples. The 6-in. inside diameter of the lip permits free entry of the core components and grapples into the CCP. The outside diameter provides a minimum of 0.035 in. radial clearance from the reactor (IVSM) and IDS sleeves for adequate guidance. Sufficient length is reserved above the core components in the CCP for grapple access and operation. The critical loading on the lip is the impact of the striking CLEM grapple, Item 5b of Table V. The lip can withstand this load as shown in Table VII.

2.2.4 Materials

All materials are RDT Standard austenitic stainless steel, Type 304H, which requires 0.04% minimum carbon content. The following RDT Standard material specifications are applicable to the CCP.

1) M 2-2T – Stainless and Low Alloy Steel Forgings (ASME SA-182 with additional requirements)

2) M 3-6T – Austenitic Stainless Steel Pipe (ASME SA-312 with additional requirements).

Weld filler metal material is Type ER308 in accordance with the ASME Code, Section II, Part C, Specification SFA-5.9 as supplemented by RDT Standard M 1-2T.

Material for the high thermal radiation emissivity coating is black chrome oxide.

2.2.5 Fabrication

The CCP is welded in accordance with the requirements of Paragraphs 1.2.10 and 1.2.12. All machined surfaces have a maximum roughness of 125 μin. arithmetic average and have a finish adequate to prevent collection of foreign material and suitable for inspection by the specified nondestructive test methods and for decontamination.

2.2.6 Special Provisions

The CCP's are primarily designed for containing fuel assemblies. Special adapters are required for handling those core components shorter than the standard fuel assembly.

2.2.7 Design Conditions

Critical design conditions for the CCP as defined in the ASME Code, Section III, are summarized in Table VII. Since the CCP is a mobile open vessel, the following definitions were adopted:

2.2.7.1 Normal: All steady-state and transient loading less than 4 g axial, 0.5 g transverse, and 920° F maximum temperature during the transfer of a CCP between the reactor and IDS. The CCP is designed to accommodate 27 normal transfers in its 10-year life without failure. No inservice inspection.

2.2.7.2 Upset: Loads caused by impact velocities up to 4 ft/min and maximum temperature up to 1270° F. The CCP is designed to accommodate a total of 27 normal or upset transfers in its 10-year-life without failure. Visual inspection for dents or leaks before return to service.

2.2.7.3 Emergency: Loads caused by vertical impact velocities up to 24 ft/min, any free fall up to 3/4 in., horizontal impact velocities up to 0.17 ft/sec, maximum temperatures up to 1270° F, and OBE seismic loads. Requalification inspection for return to service. After a second emergency condition, the CCP will be subject to automatic rejection.

2.2.7.4 Faulted: Loads caused by impact velocities up to 600 ft/min, external pressure up to 50 psi, immersion of 1270° F CCP into 500° F IDS at 24 ft/min. Automatic rejection.

None of the above conditions should result in rupture or leaks in the CCP. Only faulted conditions may result in permanent deformation.

2.2.7.5 Excluded: The integrity of the CCP may be violated under the following conditions. The protection of public health and safety is assured by the double structural containment of the plant.

1) Fuel meltdown

2) Impact velocities of more than 600 ft/min

3) Grapple impact velocity on the top of CCP greater than 24 ft/min

4) Horizontal impact loads greater than 2800 lb

5) Maximum temperatures above 1270° F with insertion velocities greater than 24 ft/min.

2.2.8 Heat Transfer

The CCP will reject up to 10-kw afterglow heat generated by the fuel element inside of it. The heat is transferred by conduction through the wall to the surrounding sodium while residing in the

reactor vessel or the IDS. Thermal radiation is the principal mode while residing in CLEM. A stream of argon gas is circulated around the CCP in the IEM cell.

3.0 SAFETY

3.1 COMPONENT MALFUNCTION

The abnormal conditions usually impairing safety caused by malfunction do not occur in the CCP. However, system malfunctions as described in Table IX may result in violation of the integrity of the CCP.

3.1.1 Fire

Sodium fire in the CCP is prevented by the inert argon cover gas surrounding the CCP during residence and transfer operations. Integrity of all sodium and cover gas containing equipment is assured by their compliance with the requirements of the pertinent sections of the ASME Boiler and Pressure Vessel Code or the ANSI Code for Pressure Piping.

3.1.2 Loss of Cooling

No apparent mechanism is available to interfere with heat conduction from the CCP when submerged in sodium except failure of the cooling system provided in the residence facility. Loss of these systems is covered in detail in the appropriate sections.

Radiant heat transfer is sensitive to the emissivity of the surfaces. Operational precautions to assure adequate emissivity for this infrequent thermal load will include visual observation of the CCP wall through the CLEM viewing port and the CCP performance history.

While the CCP is in the CLEM or IEM cell, an undetected leak in the bottom would drain sodium from the CCP which could increase the resistance to heat transfer. Certain fuel assemblies under these conditions would melt and destroy the CCP. Containment features in the other systems will protect against further damage.

3.1.3 Criticality

The CCP does not impose a criticality problem because only one fuel assembly will be transported in a pot.

3.1.4 Other System or Component Interactions

Events listed in Table VIII may occur during normal operations and under conditions defined as upset, emergency, or faulted. No leakage of sodium is permitted as a result of these accidents. Damaged pots or those with doubtful integrity after the interaction will be replaced.

TABLE VIII
PROTECTED INTERACTIONS

1.	CLEM grapple driving against the top of CCP
2.	CLEM grapple engaging with the CCP when traveling
3.	The CCP with core component and grapple hitting the support structure with its bottom after hydraulic arrest.
4.	Free fall of CCP within the grip of the grapple, with core component and sodium therein onto the grapple fingers.
5.	Free fall of grapple and CCP into dash pot tubes which will cause external and internal pressure transients on the nose.
6.	Horizontal acceleration of CLEM transporter which may cause impact on the CLEM wall.
7.	Thermal transients from normal temperature differences

Events listed in Table IX may result in violation of the integrity of the CCP, consequently leakage of sodium and possibly melted fuel. Safety provisions for these conditions are discussed in the appropriate sections for the facility or equipment involved.

TABLE IX

EXCLUDED INTERACTIONS

1.	Axial impacts to the top of the CCP by the grapple caused by velocities exceeding maximum CLEM driving velocity.
2.	Axial impacts of the pot caused by velocities exceeding hydraulic arrest velocity in sodium.
3.	Transverse impacts exceeding design loads defined in Item 4 of Table V.
4.	Fuel meltdown.

3.2 PLANT ACCIDENTS

3.2.1 Loss of Electrical Power

The CCP does not use electric power. Loss of power to the facilities or CLEM will affect the CCP temperature. This is described in the appropriate sections for the facility or equipment.

3.2.2 Tornado

The CCP is protected by the facilities and CLEM. Tornado propelled missiles cannot reach it.

3.2.3 Earthquakes

The CCP will be designed to withstand Category III seismic events. The CCP will withstand earthquake accelerations causing transverse impact loads not exceeding mechanical design loads identified in Item 4 of Paragraph 2.2.7.5. These are the maximum input acceleration requirements imposed on the facilities and CLEM.

3.3 SODIUM LEVEL CONTROL

3.3.1 Excess Sodium Disposal

The rise of sodium temperature in the full CCP during normal and abnormal operations will cause expansion and spilling of sodium over the rim of the CCP. In the reactor vessel and the IDS, the spilled sodium will flow in the sodium pool; in the CLEM it will be collected in the drip pan pot.

4.0 OPERATIONS

4.1 STARTUP

Startup operations of the CCP are performed prior to receiving the core components in the following sequence:

1) The CCP is manually inserted into the CCCS.

2) The CCCS is purged and argon gas atmosphere is established all around the CCP.

3) The CCP is preheated in the CCCS to within 50° F of the temperature of sodium in the IDS.

4) The CLEM transfers the CCP to its position in the IDS using the grapple weight to sink the CCP.

5) The sodium in the IDS fills the CCP by overflowing through the top. The displaced argon gas flows through a passage in the CLEM grapple.

The loading of the CCP into IDS during startup is characterized by the 500° F temperature and the 10-psig external pressure of sodium prior to the sodium displacing the argon fill.

4.2 NORMAL

Normal operations of the CCP are performed during the routine fuel handling procedures to move core components between the IDS and

reactor. Typically, the BLTC charges a new fuel assembly into a CCP in the IDS starting the following sequence:

1) CLEM picks up the CCP and core component. It lowers its full weight onto the CCP and extends the lifting fingers. After the grapple starts to move upward, the fingers engage the CCP lip. The hoist accelerates the load upward at less than 1 g and moves it into CLEM.

2) The CLEM Transporter moves the CLEM from the IDS to the reactor vessel.

3) The CCP is lowered into the reactor vessel: The CCP impacts at the bottom of the core support structure. The CLEM grapple comes to rest on top of the CCP, releases and retracts. The IVHM exchanges the core components setting the irradiated component onto the bottom of the CCP.

4) CLEM, using the same procedure, returns the CCP to IDS.

5) When the core component has decayed, the BLTC grapple removes the core component and replaces it with a new one to start a new cycle.

6) The CCP is also placed by CLEM into the core component conditioning container in the IEM cell where the core component is removed by the CCP grapple.

4.3 ABNORMAL

No protected abnormal condition will cause the CCP to leak.

4.3.1 Upset Conditions

Upset conditions involve higher impact loadings due to inadvertent higher impact velocities caused by misoperation of the grapple hoist.

4.3.2 Emergency Conditions

Emergency conditions involve maximum drive velocity impact of CCP and grapple, free fall impact due to slack in the grapple/CCP compliance, horizontal impact due to emergency stops of the CLEM transporter, and earthquake loads. Higher temperatures are included based on loss of forced draft cooling in CLEM.

4.3.3 Faulted Conditions

Faulted conditions involve free fall of CCP and grapples into the dash pot tube of the IDS or reactor vessel, earthquake loads, maximum temperature due to loss of cooling in CLEM or IEM cell, and maximum CLEM pull on a stuck CCP.

4.3.4 Excluded Conditions

Excluded conditions are not protected and can result in causing the CCP to leak. They include fuel meltdown inside the CCP, free

falls of grapples or CCP of more than 2 ft into unprotected areas, stuck components in a CCP, and earthquake loading greater than OBE.

5.0 MAINTENANCE

5.1 MAINTENANCE APPROACH

Due to the paramount importance of preventing leakage of the CCP, all damaged CCP's and all those subjected to faulted conditions will be replaced. CCP's removed for having been exposed to emergency conditions or for other reasons with no visually detectable damage will be subject to further examination for requalification. The damaged CCP's will be discarded; repair work will not be permitted.

5.2 COMPONENT MAINTENANCE

5.2.1 Preventive

In case of occurrence of any emergency or faulted conditions, or more severe incidents, or indication of any possible damage to the CCP for other reasons, the CCP involved will be subjected to the following maintenance activities to prevent any subsequent failure of the CCP.

1) Removal of the Core Component After any of the incidents above, the core component will be removed from the CCP. If convenient it will be removed in the facility where the incident happened. Otherwise, the CCP can be moved to another facility for core component removal.

2) Visual Inspection. The first visual inspection of the CCP with suspected damage will take place through the inspection window of the CLEM. If damage is not detected in the CLEM, the CCP will be moved to the IEM cell for additional visual inspection. In case of any damage observed during either inspection, the CCP will be discarded.

3) Removal of the CCP. Following rejection by the visual inspection, the CCP will be disposed of as waste.

4) Emptying of the Sodium. Emptying of sodium from a CCP will be performed in the IEM cell.

5) Return of the Pot to the System. The CCP requalified in accordance with Paragraph 5.2.3 will be returned to the system by the procedure specified for startup in Paragraph 4.1

5.2.2 Corrective

Since a damaged CCP will be discarded, corrective maintenance will not be performed.

5.2.3 Requalification

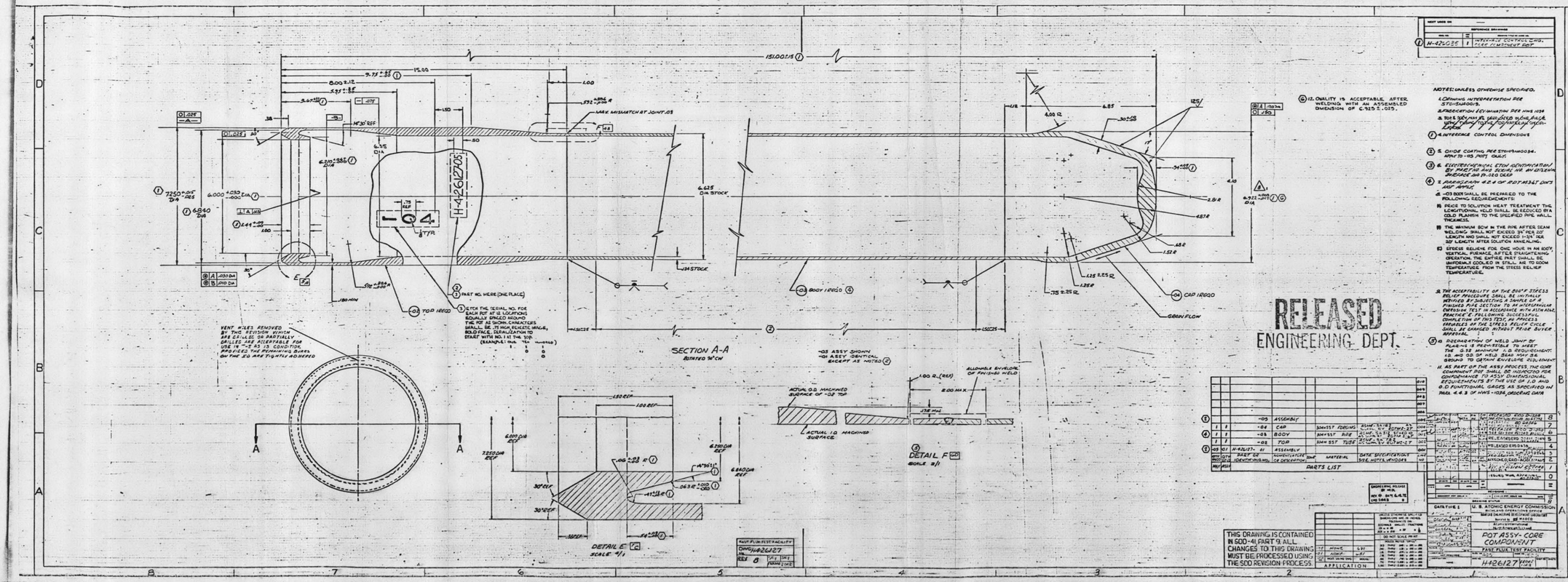
The CCP, after experiencing an emergency condition but with no damage detected by visual inspection, will be cleaned of sodium and subjected to the same nondestructive examinations and testing which were specified for the CCP in accordance with Paragrapns 1.2.9 and 1.2.10. A CCP complying with the acceptance requirements is requalified for return into the system.

6.0 APPENDICES

APPENDIX B

SDD 41, Part 9

B-1



APPENDIX C

ENGINEERING PARAMETERS
DESIGN DATA SHEET
CORE COMPONENT POT
(Sheet 1 of 8)

	Item	Design Point	Reference or Remarks
1.0	Function Requirements		
1.1	Engage to:		
	CCP Grapple	~1/yr†	
1.1.2	CLEM Grapple	1200/yr†	(CLEM Design Data)
1.2	Contain New or Irradiated Core Components:		
1.2.1	Driver Assemblies	75/yr†	For this effort, WADCO TWX 9-10-71
1.2.2	Safety, Scram, and Control Assemblies	33/yr†	
1.2.3	Inner Reflector Assemblies	36/yr†	To be considered later by HEDL - WADCO TWX 9-10-71
1.2.4	Outer Reflector Assemblies		
1.2.5	Core Restraint Static Pins	~6/yr†	
1.2.6	Shortened Open Test Assemblies	6 to 9/yr†	
1.3	Pot Resides in:		
1.3.1	CLEM	2 hr/yr/pot	Average values based on an inventory of 120 pots

†Total - Divide by number of pots in inventory to get average function per pot.

APPENDIX C

ENGINEERING PARAMETERS
DESIGN DATA SHEET
CORE COMPONENT POT
(Sheet 2 of 8)

Item		Design Point	Reference or Remarks
1.3.2	Reactor	3.3 hr/yr/pot	Average values based on an inventory of 120 pots
1.3.3	IEM Cell	0.7 hr/yr/pot	
1.3.4	IDS	8760 hr/yr/pot	
1.3.5	CCCS	0.01 hr/yr/pot	
1.4	Function — No Function Limits		
1.4.1	Free-Fall Velocity	10 ft/sec	Any greater velocity is to be absorbed in the primary system
1.4.2	Maximum Bow of Core Component	0.9 in.	Measured from a chord line
1.4.3	Vertical Impact to Top	600 ft-lb	At V_o = 0.4 ft/sec
1.4.4	Thermal Shock	-	1500° F pot entering 500° F sodium at velocity 24 ft/min
2	Design Requirements		
2.1	Number Required	120	
2.2	Design Life	10 yr	SDD 41
2.3	Environment	-	Sodium and argon cover gas (for residence location and duration, see Item 1.3 in Design Parameters)

APPENDIX C

ENGINEERING PARAMETERS
DESIGN DATA SHEET
CORE COMPONENT POT
(Sheet 3 of 8)

Item		Design Point	Reference or Remarks
2.4	Thermal		
2.4.1	Isothermal (or maximum fuel pin temperature) Normal	1000° F	SDD 41
2.4.2	Isothermal (or maximum fuel pin temperature) Emergency	1500° F	SDD 41
2.4.3	ΔT (maximum) Normal	500° F	Assume IDS is 500° F
2.4.4	ΔT (maximum) Emergency	1000° F	
2.4.5	Rate of Change (maximum)	350° F/min	Emersion at 4.5 ft/min (CLEM)
2.4.6	Heat Dissipation (maximum)	10 kw	Surface 1000° F SDD 41 (1-6)
2.5	Pressure		
2.5.1	Internal – Static	10 lb/in.	
2.5.2	Internal – Dynamic	500 lb/in.	Varies maximum at bottom to 0 at top
2.5.3	External – Static	10 lb/in.	
2.5.4	External – Dynamic	100 lb/in.	On nose only in dash pot situation
2.6	Leak rate		
2.6.1	Na (through walls of pot)	0 lb/sec	

APPENDIX C

ENGINEERING PARAMETERS
DESIGN DATA SHEET
CORE COMPONENT POT
(Sheet 4 of 8)

Item		Design Point	Reference or Remarks
2.6.3	Maximum Overflow Due to Temperature Increase	2 in.^{3}/min	
2.7	Dimensions		
2.7.1	Maximum Length	151 in.	
2.7.2	Maximum Diameter	7.260 in.	
2.7.3	Displaced Volume	3 ft^3	
2.7.4	Internal Volume	2.8 ft^3	
2.7.5	Ovality	See note	Standard 6-in. Sch. 10 pipe. Not more than ±0.15 combined in any combinations of the two measurements from a true cylinder.
2.7.6	Straightness (internal surface)	See note	
2.7.7	Concentricity of Pot and F/A Top	0.15 in.	Measured as a radius
2.8	Weight		
2.8.1	Dry	125 lb	
2.8.2	Wet	112 lb	Under Na at 500° F
2.9	Motion		
2.9.1	Vertical Velocity — Normal	0 to 16 ft/min	CLEM

APPENDIX C

ENGINEERING PARAMETERS
DESIGN DATA SHEET
CORE COMPONENT POT
(Sheet 5 of 8)

	Item	Design Point	Reference or Remarks
2.9.2	Vertical Velocity – Emergency	0 to 24 ft/min	CLEM
	– Free Fall	See 1.4.1, ft/min	
2.9.3	Horizontal Velocity – Normal	0 to 25 ft/min	CLEM Transporter
2.9.4	– Emergency	0 to 25 ft/min	CLEM Transporter
2.9.5	Maximum Vertical Acceleration – Normal	128.8 ft/sec^2	CLEM Hoist
2.9.6	– Emergency – Impact	>132 ft/sec^2 11500 ft/No.	Terminal conditions after free fall into reactor or IDS mounting tubes
2.9.7	Maximum Horizontal Acceleration – Normal	0.04 ft/sec^2	CLEM Transporter
2.9.8	– Emergency	Impact	1 in. free swing to cold wall which is decelerating at 0.17 ft/sec^2 from 25 ft/min
2.9.9	Seismic		See JABE-WADCO-02 and BLC-1762. Other structures must protect pot as part of the permanent structure.
2.10	Loads		
2.10.1	Vertical – Static External	1500 lb	CLEM Grapple
2.10.2	– Static Internal	640 lb	(Reflector)

APPENDIX C

ENGINEERING PARAMETERS
DESIGN DATA SHEET
CORE COMPONENT POT
(Sheet 6 of 8)

	Item	Design Point	Reference or Remarks
2.10.3	Vertical – Dynamic External	~15,000 lb	CLEM grapple striking at 25 ft/min
2.10.4	– Dynamic Internal	3460 lb	
2.10.5	Horizontal – Static	about 0 lb	Small horizontal force due to tilted core component in CCP
	– Dynamic	4325 lb or 5 g	
2.11	Radiation Exposure – Gamma	10^5 R/hr	No material damage expected in 10-yr exposure)
	– Fast Neutrons	10^5 n /cm^2/sec	
3	Safety and Hazards		
3.1	Codes		ASME Boiler and Pressure Vessel Code Section III, Class 1
3.2	Collection of Overflow Na		Return to primary system or to drip pans
4	Operation		
4.1	Checkout	-	None required
4.2	Normal Operation		
4.2.1	Heat Transfer	0 to 10 kw	By thermal convection inside and by conduction to Na or radiation to equipment walls

APPENDIX C

ENGINEERING PARAMETERS
DESIGN DATA SHEET
CORE COMPONENT POT
(Sheet 7 of 8)

	Item	Design Point	Reference or Remarks
4.2.2	Shock Load to Core Component		
	Maximum Vertical	-	
	Maximum Horizontal	-	No requirement, TWX – WADCO 9-9-71
4.2.3	Core Component Bow Accepted (maximum)	0 to 0.9	
4.2.4	Orientation (rotation)	-	No requirement
4.2.5	Filling		
	Na	-	Submerge in primary coolant using grapple weight
4.2.6	Venting	100%	All gas and liquids freely escape through top
4.2.7	Draining	0%	No provision for draining
4.3	Emergency Operation		
4.3.1	Fuel Meltdown	-	No requirement – may melt through. SDD 41 (4-14)
4.3.2	Dropping by CLEM	-	No requirement (3/4 in. free fall maximum)
4.3.3	Jammed Core Component	-	No requirement

APPENDIX C

ENGINEERING PARAMETERS
DESIGN DATA SHEET
CORE COMPONENT POT
(Sheet 8 of 8)

Item		Design Point	Reference or Remarks
4.3.4	Jammed or Broken Pot	-	No requirement
5	Maintenance		
5.1	Draining	100%	
5.2	Cleaning	-	No crevices or joints which are inaccessible
5.3	Leakage	-	Replace pot
5.4	Distortion	-	Replace pot
5.5	Requalification	-	Pressure test and straightness test (per HWS 1034)