Section 1.0

INTRODUCTION AND GENERAL DESCRIPTION OF THE PLANT -- PRIMARY SIDE SAFEGUARDS SYSTEM

1.1 INTRODUCTION

The Westinghouse Electric Corporation, in an interim step towards attaining one-step design certification for the standardized Westinghouse Advanced Pressurized Water Reactor (WAPWR) Nuclear Power Block design, is developing a Reference Safety Analysis Report; Standard Plant for the 90's with the objective of obtaining a Preliminary Design Approval (PDA).

The PDA-level Safety Analysis Report is generally being prepared and submitted to the NRC in a modular, system-by-system format. The formatting technique provides essentially all of the information associated with a particular system or major component in one package. Regulatory Guide 1.70, Revision 3 numbering and titles were retained to facilitate NRC dissemination and review. In addition, where Westinghouse has determined that the NRC review efficiency may be further enhanced by treating certain interfacing safety analysis report chapters as separate modules, references to such modules are made as appropriate in lieu of repeating such information in several modules.

1.2 GENERAL PLANT DESCRIPTION

1.2.3 Plant Description

1.2.3.1 Primary Side Safeguards System

The Primary Side Safeguards System (PSSS) for the WAPWR is the Westinghouse Integrated Safeguards System (ISS).

1.2.3.1.1 System Functions

The ISS performs the follow ng safety functions:

- o Emergency core cooling in the event of a loss of coolant accident (LOCA), defined as a pipe break, a spurious relief or a safety valve opening in the RCS, a rod ejection accident, or a steam tube rupture accident.

- o Emergency shutdown reactivity insertion (boration) in the event of a steam break accident defined as a pipe break, a spurious relief or a safety valve opening in the secondary system.

- o Emergency core cooling in the event of a secondary side heat sink accident, defined as a loss of feedwater event followed by a failure of the auxiliary feedwater system.

- o Containment spray in the event that a LOCA or steam break accident resulted in sufficient energy being released to the containment such that the high containment pressure setpoint was exceeded.

- o Emergency letdown and boration of the RCS in the event that the conventional chemical and volume control system boration capability was lost.

o Normal and emergency heat removal during plant cooldown in conjunction with the secondary side heat sink.

More specifically, the emergency core cooling function of the ISS is to provide sufficient borated water to the reactor coolant system (RCS) to limit core damage and metal-water reaction. In the event of a large LOCA, where essentially all of the reactor coolant volume has been displaced, the ISS function is to rapidly refill the reactor vessel, reflood the core, remove the decay heat, and eventually terminate boiling by establishing and maintaining subcooled flow through the core. In the event of a more probable small LOCA, the ISS function is to prevent any substantial peak clad temperature by providing sufficient borated water to prevent core uncovery and to eventually establish and maintain subcooled flow through the core.

The function of the ISS following a steam break accident is to inject sufficient borated water into the RCS with additional shutdown reactivity to counteract the reactivity increase caused by the resulting system cooldown and to compensate for the change in the RCS volume.

In the event of a loss of secondary side heat sink accident the function of the ISS, in conjunction with a safety-grade pressurizer vent system, is to inject sufficient borated water at a sufficiently high pressure to prevent any substantial peak clad temperature by preventing core uncovery and to eventually establish and maintain subcooled flow through the core.

The containment spray function of the ISS, in the event of a large LOCA or steam break, is to (1) provide sufficient flow to the containment spray ring header to reduce the iodine and particulate fission product inventories in the containment atmosphere; and (2) remove sufficient heat from the containment atmosphere, in conjunction with the containment fan cooler system, to maintain the containment pressue below the containment design pressure.

The emergency letdown and boration function of the ISS provides an alternate means to obtain cold shutdown boron concentration in the reactor coolant system prior to the depressurization and cooldown of the plant. Normally the CVCS would be utilized for this function, but in the event that the CVCS letdown/boration capability was not available the ISS would provide the emergency means to achieve cold shutdown conditions in conjunction with the secondary side heat removal systems and the safety grade pressurizer vent system.

The normal heat removal function of the ISS is identical to the conventional residual heat removal system function. The secondary side heat removal system would be utilized to cooldown the plant from hot shutdown conditions to the cut in temperature for the primary side heat removal system (ISS). The ISS would be utilized to cooldown the plant to cold shutdown conditions and maintain the plant at cold shutdown conditions indefinitely. At low RCS pressure, the ISS also provides an RCS cleanup and pressure control function in conjunction with the CVCS.

1.2.3.1.2 System Description

The ISS consists of four identical and totally separated mechanical subsystems, which are powered from either two or four separate and redundant emergency electrical power trains, and receive actuation signals from either two or four separate and redundant actuation cabinets. One subsystem is shown schematically in Figure 1.2.1-1 in its normal valve alignment. Figure 1.2.1-2 provides a simplified schematic of the four mechanical subsystems. Figure 6.3-1 contains the detailed ISS design.

The basic configuration consists of:

- o Four pumping modules each containing one high head and one low head pump

- o An emergency water storage tank located inside the containment building

- o Four accumulators

- o Four core reflood tanks

- o Four residual heat removal heat exchangers

The accumulators, core reflood tanks and heat exchangers are located inside the containment building. It is proposed that the four pumping modules be housed in containment Pressure Pump Enclosures (CPPE's) in order to encompass all piping and components associated with any post accident recirculation of highly radioactive fluid within a containment boundary. This total containment encapsulation concept for the ISS eliminates the potential for post accident releases of highly radioactive liquid or gases into the auxiliary building and subsequently into the environment.

The four pumping modules, are totally independent and identical to each other. The ISS concept recommends that two of the modules be located on the opposite side of the containment 180 degrees apart from the other two modules. This arrangement is shown schematically in Figures 1.2.1-2 and 1.2.1-3. Each pumping module contains one low head pump, one low head pump miniflow heat exchanger, one high head pump and the associated piping and valves necessary for these pumps to perform their intended safety functions.

The high head pumps, which perform the safety injection function, are aligned to take suction from the Emergency Water Storage Tank (EWST) and to deliver coolant to the reactor coolant system via the residual heat removal heat (RHR) exchangers and the four separate reactor vessel injection nozzles. The EWST is located at a low elevation inside the containment building.

The low head pumps are primarily residual heat removal pumps, which are used for plant cooldown and during refueling operations to remove decay heat. During residual heat removal operation they take suction from the Reactor Coolant System hot legs and recirculate coolant through the core via the RHR heat exchangers and the four reactor vessel injection nozzles. However, during a LOCA or steam break accident, these pumps function as containment spray pumps. They are aligned to take suction from the EWST and deliver to the containment spray ring headers on receipt of a high containment pressure actuation signal.

The four core reflood tanks provide a supplemental injection flow to the reactor coolant system (RCS) during the post accident reflood phase following an intermediate to large LOCA. The core reflood tanks represent passive injection subsystems which deliver coolant to the RCS via the four reactor vessel injection nozzles. These passive subsystems are low pressure, high resistance, low flow systems.

The four accumulators provide rapid reflood of the reactor vessel lower plenum and downcomer volumes following an intermediate to large LOCA. The accumulator represents a passive injection subsystem which delivers coolant to the RCS via the four RCS cold legs. The accumulators are high pressure, low resistance, high flow systems.

In the event that the normal CVCS letdown/boration capability was not available, feed and bleed emergency letdown/boration operation would be utilized to achieve a cold shutdown boration of the RCS prior to emergency plant cooldown operations. The CVCS letdown heat exchangers, located inside the containment would permit the letdown flow to be subcooled before it is released into the EWST. The high head pumps would be used during this operation to provide the makeup/borated coolant to the RCS from the EWST.

If four emergency electrical power trains are provided, the electrical loads associated with each ISS subsystem are assigned to one of the four separate and redundant load groups or emergency electrical power trains. These loads are connected to four separate safeguards vital busses. Each safeguards vital bus is connected to an offsite power source. However, in the event that offsite power is lost each vital bus is automatically connected to one of four emergency diesel generators.

However, if only two emergency electrical power trains are provided, the electrical load associated with two of the four ISS subsystems are assigned to one of the two separate and redundant load groups or emergency electrical power trains while the electrical loads associated with the other two ISS subsystems are assigned to the second emergency electrical power train. Only two safeguards vital busses and two emergency diesel generators would be associated with two emergency electrical trains.

1.2.3.1.2.1 Safety Injection

The four high head pumps are the safety injection pumps. In the event that a safety injection ("S") signal were initiated, these pumps would start automatically and inject coolant directly into the reactor vessel downcomer. Each high head pump is aligned to take suction from the Emergency Water Storage Tank (EWST) located inside the containment and to deliver directly to the reactor vessel. All valves in this flow path are normally open. Therefore, the only action required to establish emergency core cooling is the automatic starting of the high head pumps. There are no piping interconnections between these four separate high head subsystems. The four high head pumps are sized such that one high head pumps would be sufficient to prevent any period of core uncovery for small LOCA's up to at least 6 inch diameter break size. Each high head pumping system is provided with a normally closed flow path to a corresponding RCS hot leg. Several hours after a LOCA all ISS pumping systems could be temporarily realigned for hot leg recirculation to ensure termination of boiling within the core.

In the event of a steam break accident the high head pumps inject borated water into the Reactor Coolant System (RCS) with sufficient shutdown reactivity to counteract any reactivity increase caused by the resulting system cooldown and to compensate for the change in the RCS volume. The high head pumps would continue injecting borated water following a steam break until the initial RCS volume had been reestablished with borated water to prevent the possibility of a return to criticality.

The EWST provides a continuous suction source for the high head pumps thus eliminating the conventional realignment from the Refueling Water Storage Tank (RWST) to the containment sump. In the event of any LOCA, the coolant spills to the EWST thus establishing a continuous recirculation path between the EWST, the high head pumps, and the RCS. Since the EWST is located inside the containment, the initial EWST water temperature is approximately 100°F compared to the minimum 32°F RWST temperature which may exist in conventional plants, thereby reducing the potential for thermal shock to the RCS. The conventional realignment from the 32°F RWST water temperature to a maximum 300°F containment sump water temperature imposes a thermal transient on the safety injection equipment, which has been essentially eliminated by the EWST arrangement.

The four accumulators are primarily responsible for rapidly refilling the reactor vessel lower plenum and downcomer following a major blowdown of the RCS that would occur with a large or intermediate LOCA. The four core reflood tanks provide a diverse/passive means to reflood or supplement the reflooding of the core thus eliminating the need for large capacity low head safety injection pumps.

Since the core reflooding phase occurs over a finite time period and imposes the largest flow requirement on the safeguards pumps, the core reflood tanks provide a means to reduce the flow requirement on the pumping system as well as provide a diverse and passive means to meet the large break LOCA functional requirement.

The four core reflood tanks and the four high head pumps provide eight separate means for injecting coolant directly into the reactor vessel. Any combination of five of these eight entries are sufficient to meet the large break functional requirements.

One RHR heat exchanger is installed in each of four high pressure injection headers that are routed from the four high head pumps to the four reactor vessel ISS injection nozzles. These high pressure heat exchangers are located inside the containment building. In the event of a LOCA, these heat exchangers are available to remove heat from the EWST recirculation water regardless of the break size since they ar[illegible]ated between the high head pump and the reactor vessel flow path.

1.2.3.1.2.2 Containment Spray

The four low head pumps are primarily RHR pumps which would be used for normal plant cooldown and during normal refueling operations to remove the core decay heat. However, in case of a loss of coolant or steam break accident these low head pumps would function as containment spray pumps.

The ISS - Containment Spray System has a dual function of fission product removal and pressure suppression/heat removal following a major mass/energy release within the containment. However, a safeguard containment fan cooling system is provided as an integral part of the post-accident containment heat removal system, therefore the performance requirements for the ISS - containment spray subsystem are based on providing sufficient flow to the containment spray ring headers to ensure coverage of the containment cross-sectional area with minimum safeguards operation.

In the event of a high containment pressure signal ("P" signal) during reactor power operation, the four low head pumps would receive an automatic signal to start. Also the valves in the pump discharge headers would receive an automatic signal to open. The low head pumps would function as containment spray pumps and would draw suction from the EWST and deliver to the containment spray headers, which are located in the top of the containment building.

A design flow of approximately [ ] gpm at a containment pressure of [ ] psig (a,c)
has been established for an assumed [ ] foot diameter spherical containment. (a,c)
This design flow rate is based on an assumed spray ring header layout and nozzle type, orientation and spacing that would ensure that the maximum containment volume coverage was obtained. A SPRACO 1713A spray nozzle has been assumed with a pressure drop of [ ] psig at a spray nozzle design flow (a,c)
rate of [ ] gpm. (a,c)

Each low head pump is capable of providing [ ] gpm at a [ ] psi containment (a,c)
pressure, therefore two of the four low head pumps are required to meet the [ ] gpm spray design flow rate. (a,c)

Two redundant sets of ring headers, are recommended. One half of each set of ring headers would be assigned to one ISS spray subsystem. A staggered assignment of ring header sections to each ISS spray subsystem assures the maximum containment coverage with any two spray pumps operating. For example, each spray pump would deliver to 1/2 of a inner ring, 1/2 of a middle ring, and 1/2 of an outer ring. However, the 1/2 inner ring and 1/2 outer ring would provide spray to the opposite side of the containment from the 1/2 middle ring. A second spray pump would be assigned to deliver to the matching spray header segments so that the operation of two spray pumps delivering to matching ring header segments assure 100 percent containment coverage with 100 percent of the required spray flow.

A 90° relative orientation between the two sets of ring headers is also necessary to assure that the maximum containment coverage will be obtained with any two spray pumps operating. This orientation would ensure a 75 percent containment coverage with 100 percent of the required flow even if the two operating ISS spray systems are delivering to unmatched ring header segments. For an ISS powered by four emergency electrical power trains, each low head spray pumping system can be assigned to any one of the four groups of ring headers, (each group consisting of 1/2 inner, 1/2 middle, and 1/2 outer ring). For an ISS powered by two emergency electrical power trains, spray subsystems assigned to the same electrical train must be assigned to deliver to a matched set of ring headers to ensure 100 percent containment coverage with a single electrical train failure. Note that when spray recirculation is no longer required, the low head pumps may be aligned for long-term safety injection recirculation, thereby providing 4 additional pumps for long-term cooling where only one is needed.

1.2.3.1.2.3 Normal Cooldown

During a normal plant cooldown, letdown and boration are provided by the Chemical and Volume Control System (CVCS). Following initial cooldown of the plant by steam dump to the main condenser, the four low head pumps would be aligned to recirculate reactor coolant through the core by taking suction from the RCS hot legs and returning the coolant to the reactor vessel through the four RHR heat exchangers. The four RHR pumps and four heat exchangers would be capable of reducing the RCS coolant temperature from 350°F to 150°F in less than 16 hours following reactor shutdown. It should be emphasized that the ISS provides four RHR subsystems which would permit three of four subsystems to be taken out of service during long-term shutdown operation, or permits maintenance of one subsystem without losing single-failure proof core cooling capability.

1.2.3.1.2.4 Emergency Boration

In this mode of operation, non-safety grade systems are assumed to be unavailable. The high head pumps provide a means of emergency boration of the RCS independent of the conventional CVCS letdown and charging paths. Two high head pumps in conjunction with two safety grade letdown lines and CVCS letdown heat exchangers, located inside the containment, provide two redundant emergency letdown paths. The emergency boration/letdown is accomplished by initially depressurizing the RCS by temporarily opening pressurizer vent valves until the RCS pressure is below the shutoff head of the high head pumps. A semi-closed recirculation loop from the RCS hot legs to the EWST via the CVCS letdown heat exchangers, from the EWST to the high head pumps, and from the pumps back into the RCS, can be established. The volume and boron concentration of the EWST are more than adequate to raise the RCS boron concentration to the required level. The two emergency letdown flow paths, from the RCS hot legs to the EWST (via the CVCS letdown heat exchangers) eliminates flooding of the containment building and permits the letdown flow to be subcooled before it is released into the EWST.

The initial cooldown is then accomplished by the secondary side safeguard system until the low head pumps can be aligned for RHR operation.

1.2.3.1.2.5 System Testing

The ISS provides a means for performing a total system and pump performance test during reactor power or shutdown operations. Each low head and high head pump is aligned to take suction from the EWST and can be aligned to discharge back into the EWST via a system performance test flow path located downstream of each RHR heat exchanger. It is recommended that a full flow system and pump performance test be performed during each major refueling operation or periodic shutdown. The entire pump performance curve can be verified from miniflow to pump runout during these tests. Quarterly miniflow tests (which would require no valve repositioning) are recommended for ISS pumps. In the event that the miniflow tests produce unacceptable pump characteristics, additional pump performance data can be obtained during reactor power operations. This system performance test capability may also be utilized should major pump maintenance or replacement be required during reactor power operations.

1.2.3.1.2.6 Feed and Bleed Emergency Core Cooling

The ISS high head pumps in conjunction with the safety grade pressurizer vent system provide an emergency feed and bleed core cooling function in the event of a loss of secondary side heat sink. A loss of secondary side heat sink is defined as a loss of main feedwater followed by a failure of the startup feedwater system and also the failure of all secondary side safeguard systems. A loss of all secondary side heat removal capability would lead to steam generator dryout and a RCS pressure increase to the pressurizer power operated relief valve (PORV) setpoint. The PORV would discharge to the pressurizer relief tank (PRT) which could overflow to the EWST.

The operator is instructed to initiate emergency feed and bleed operation, after a loss of the secondary side heat removal system, whenever the RCS coolant temperature or pressure increases above the no load parameters, thus indicating no heat rejection to the secondary side. The operator would first open the safety grade pressurizer vent system, then start one or more of the ISS high head pumps. After the feed and bleed operation was established and the pressurizer water level confirmed, the operator could establish one or both of the emergency letdown paths from the RCS hot legs to the EWST via the CVCS letdown heat exchangers located inside containment. The flow rate through the CVCS letdown heat exchangers would be controlled by the operator to ensure that subcooled flow returned to the EWST. The letdown heat exchanger would transfer heat from the containment via the component cooling water system.

Eventually, the pressurizer vent valves could be closed and the RCS would be maintained in a subcooled condition by the ISS high head pumps injecting EWST water directly into the reactor vessel downcomer with letdown flow to the EWST via the CVCS letdown heat exchanger. Component cooling water to the corresponding RHR heat exchanger, downstream of the operating high head pumps, would provide additional heat removal capability. Optionally, a low head pump could be aligned to recirculate the EWST water through its corresponding RHR heat exchanger with direct flow path back to the EWST via a system test line, providing additional heat removal from the EWST fluid to the component cooling water system.

See Sections 3.0, 5.4.7, 6.2.2, 6.3, 6.5.2, and 15.0 for a complete design description and evaluation of the ISS.

(a,c)

FIGURE 1.2.1-1 ONE OF FOUR INTEGRATED SAFEGUARDS SUBSYSTEMS NORMAL VALVE ALIGNMENT

(a,c)

FIGURE 1.2.1-2 INTEGRATED SAFEGUARDS (FOUR MECHANICAL SUBSYSTEMS)

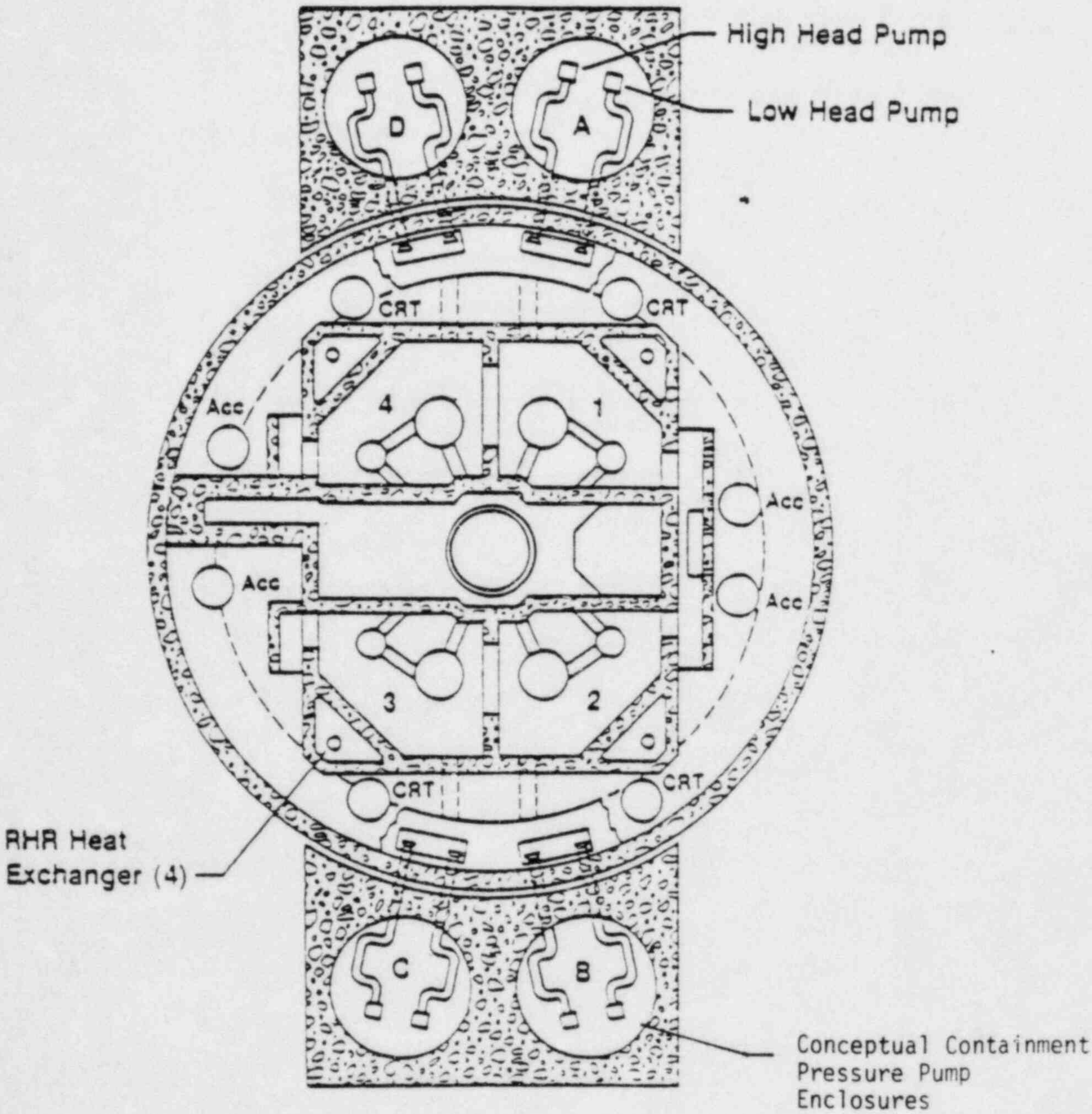

FIGURE 1.2.1-3 CONCEPTUAL CONTAINMENT PLAN

1.3 COMPARISON TABLES

1.3.1 Comparison With Similar Facility Designs

Table 1.3-1 presents a design comparison of the major parameters and features of the WAPWR ISS with RESAR-414 (Docket No. STN-50-572; PDA-13), RESAR-3S (Docket No. STN-50-545; PDA-7), and RESAR-41 (Docket No. STN-50-480; PDA-3).

TABLE 1.3-1 (Sheet 1 of 2)

DESIGN COMPARISON

Parameter or Feature	RESAR-SP/90	RESAR-414	RESAR-3S	RESAR-41
Residual heat removal				
1. Initiation pressure (psig)	~ 425	~ 425	~ 425	~ 400
2. Initiation/completion temperature (°F)	~350/150	~350/140	~350/140	~350/140
3. Component cooling water design temperature (°F)	105	105	95	105
4. Cooldown time after initiation (hr)	~ 16	~ 16	~ 16	~ 8
5. Heat exchanger removal (10^6 Btu/hr)	[ ] (a,c) (4 provided)	46.5	37.4	39.4
Accumulators				
1. Number	4	4	4	4
2. Operating pressure, minimum (psig)	600	700	600	600
3. Nominal operating water volume, each (ft^3)	[ ] (a,c)	1,400	850	1,500

TABLE 1.3-1 (Sheet 1 of 2)

DESIGN COMPARISON

Parameter or Feature	RESAR-SP/90	RESAR-414	RESAR-3S	RESAR-41
Core reflood tanks				
1. Number	4 (a,c)	N/A	N/A	N/A
2. Operating pressure, minimum (psig)		N/A	N/A	N/A
3. Nominal operating water volume, each (ft^3)		N/A	N/A	N/A
Pumps				
1. HHSI(2)				
Number	4 (a,c)	2	2	3
Runout flow (gpm)		2200	660	1600
Shutoff head (psi)		1600	1600	1600
2. LHSI(2)				
Number	0	0	0	3
Runout flow (gpm)	N/A	N/A	N/A	2900
Shut off head (psi)	N/A	N/A	N/A	300
3. RHR(4)				
Number	4(1)	2(2)	2(2)	3(3)
Runout flow		5500	5500	4000
Shutoff head (psi)	(a,c)	195	195	120
4. Containment Spray(1)				
Number	N/A	2	2	3
Runout flow	N/A	4500	4000	2900
Shutoff head	N/A	260	240	300

(1) Provides containment spray function.
(2) Provides ECCS function.
(3) Not used for ECCS function.
(4) Provides RHR function.

1.6 MATERIAL INCORPORATED BY REFERENCE

The WAPWR ISS module incorporates, by reference, certain topical reports. The topical reports, listed in Table 1.6-1, have been filed previously in support of other Westinghouse applications.

The legend for the review status code letter follows:

A - U.S. Nuclear Regulatory Commission review complete; USNRC acceptance letter issued

AE - U.S. Nuclear Regulatory Commission accepted as part of the Westinghouse emergency core cooling system (ECCS) evaluation model only; does not constitute acceptance for any purpose other than for ECCS analyses.

B - Submitted to USNRC as background information; not undergoing formal USNRC review

O - On file with USNRC; older generation report with current validity; not actively under formal USNRC review

N - Not applicable; that is, open literature, etc.

U - Actively under formal USNRC review

TABLE 1.6-1
MATERIAL INCORPORATED BY REFERENCE

REPORT NO.	TITLE	USNRC SUBMITTAL	REFERENCE SECTION(S)	REVIEW STATUS
WCAP-7198-L (Proprietary)	Evaluation of Protective Coatings* for Use in Reactor Containments	April 1968	6.1.1	A
WCAP-7798-L (Proprietary)	Behaviour of Austenitic Stainless Steel in Post-Hypothetical Loss-of-Coolant Environment	Nov. 1971	6.1.1	A
WCAP-7803	Behaviour of Austenitic Stainless Steel in Post-Hypothetical Loss-of-Coolant Environment	Dec. 1971	6.1.1	A
WCAP-7825	Evaluation of Protective Coatings for Use in Reactor Containments	Dec. 1971	6.1.1	A
WCAP-8170 (Proprietary)	Calculational Model for Core Reflooding After a Loss-of-Coolant Accident (WREFLOOD Code)	June 1974	15.6.7	AE
WCAP-8171	Calculational Model for Core Reflooding After a Loss-of-Coolant Accident (WREFLOOD Code)	June 1974	15.6.7	AE
WCAP-8200 Rev. 2 (Proprietary)	WFLASH: A Fortran IV Computer Program for Simulation of Transients in a Multi-Loop PWR	July 1974	15.6.7	AE
WCAP-8258-R1 *	SPRACO Model-1713A Nozzle Spray Drop-Size Distribution	Jan. 1974	6.5	A
WCAP-8261 Rev. 1	WFLASH: A Fortran IV Computer Program for Simulation of Transients in a Multi-loop PWR	July 1974	15.6.7	AE
WCAP-8302 (Proprietary)	SATAN VI Program: Comprehensive Space-Time Dependent Analysis of Loss-Of-Coolant	June 1974	15.6.7	AE

TABLE 1.6-1 (Cont)
MATERIAL INCORPORATED BY REFERENCE

REPORT NO.	TITLE	USNRC SUBMITTAL	REFERENCE SECTION(S)	REVIEW STATUS
WCAP-8306	SATAN VI Program: Comprehensive Space-Time Dependent Analysis of Loss-of-Coolant	June 1974	15.6.7	AE
WCAP-8326	COCO: Containment Pressure Analysis Code	June 1974	15.6.7	AE
WCAP-8327 (Proprietery)	COCO: Containment Pressure Analysis Code	June 1974	15.6.7	AE
WCAP-8339	Westinghouse ECCS Evaluation Model-Summary	July 1974	15.6.7	AE
WCAP-8340 (Proprietary)	Westinghouse ECCS Plant Sensitivity Studies	July 1974	15.6.7	AE
WCAP-8341 (Proprietary)	Westinghouse ECCS Evaluation Model Sensitivity Studies	July 1974	15.6.7	AE
WCAP-8342	Westinghouse ECCS Evaluation Model Sensitivity Studies	July 1974	15.6.7	AE
WCAP-8356	Westinghouse ECCS Plant Sensitivity Studies	July 1974	15.6.7	AE
WCAP-8370	Westinghouse Water Reactor Divisions Quality Assurance Plan		17.1	A
WCAP-8376	Iodine Removal By Spray in the Joseph M. Farley Station Containment		6.5	O
WCAP-8970-P-A (Proprietary)	Westinghouse ECCS Small Break October 1975 Model	April 1977	15.6.7	U
WCAP-8971	Westinghouse ECCS Small Break October 1975 Model	April 1977	15.6.7	U
WCAP-9220-P-A (Proprietary)	Westinghouse ECCS Evaluation Model 1981 Version	Dec. 1981	15.6.7	U
WCAP-9221	Westinghouse ECCS Evaluation Model 1981 Version	Feb. 1978	6.2.1.3	U
WCAP-9221-P-A Rev. 1	Westinghouse ECCS Evaluation Model, 1981 Version	Dec. 1981	15.6.7	A
WCAP-9226	Reactor Response to Excessive Secondary Steam Releases	Jan. 1978	15.1.6	U

TABLE 1.6-1 (Cont)
MATERIAL INCORPORATED BY REFERENCE

REPORT NO.	TITLE	USNRC SUBMITTAL	REFERENCE SECTION(S)	REVIEW STATUS
WCAP-8301 (Proprietary)	LOCTA-IV Program; Loss-of-Coolant Transient Analysis	July 1974	15.6.7	A
WCAP-8305	LOCTA-IV Program; Loss-of-Coolant Transient Analysis	July 1974	15.6.7	A
WCAP-7931 (Proprietary)	PWR Flecht Final Report Supplement	Oct. 1972	15.6.7	O
WCAP-8565-P-A (Proprietary)	Westinghouse ECCS-Four Loop Plant (17x17) Sensitivity Studies	July 1975	15.6.7	A
WCAP-8566-A	Westinghouse ECCS-Four Loop Plant (17x17) Sensitivity Studies	July 1975	15.6.7	A

1.7 DRAWINGS AND OTHER DETAILED INFORMATION

1.7. Piping and Instrumentation Diagrams

Table 1.7-1 contains a list of each piping and instrumentation diagram and the corresponding ISS figure number. Figure 1.7-1 illustrates and defines symbols and abbreviations used in the diagrams.

Also Available On
Aperture Card

TI
APERTURE
CARD

Figure 1.7-1
(Sheet 1 of 2)

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(a,c)

Also Available On
Aperture Card

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CARD

Figure 1.7-1
(Sheet 2 of 2)

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TABLE 1.7-1

Piping and Instrumentation Diagrams

Figure No.	Sheet[1]	Title
6.3-1	1-7	Integrated Safeguards System (Safety Injection/Residual Heat Removal/Spray Systems) Flow Diagram

Note (1): Only Sheets 1, 5, 6, 7 are provided. Sheet 1 is typical of Sheets 2, 3, and 4.

1.8 CONFORMANCE WITH THE STANDARD REVIEW PLAN

A listing of NRC Division 1 Regulatory Guides which are pertinent to the WAPWR ISS can be found in Section 7.0 of the "Regulatory Conformance" module. A discussion of the extent to which the WAPWR complies with these Regulatory Guides is found in Table 1.8-2.

In accordance with 10CFR50.34(g), Table 1.8-1 identifies and evaluates deviations from the acceptance criteria of those sections of the NRC Standard Review Plan (NUREG-0800) pertinent to the ISS.

TABLE 1.8-1
STANDARD REVIEW PLAN DEVIATIONS

SRP Acceptance Criteria	Deviation/Justification	Section
SRP 6.5.2-1.a: The containment spray system (CSS) should be designed to transfer automatically from the injection mode to the recirculation mode to assure continuous operation until the iodine removal design objectives have been achieved. In all cases the operating period should not be less than two hours.	The CSS/EWST design requires no switchover from injection to recirculation.	6.2.2.2
SRP 6.5.2-1.e: The pH of the spray solution should be in the range of 8.5 to 10.5.	The APWR design incorporates boric acid spray without sodium hydroxide additive. The pH of this solution will be in the range of 5 to 6.	15.6.4, 6.5.2
The iodine partition coefficient assigned for boric acid spray (1500-2500 ppm boron) is 50.	The spray effectiveness evaluation for the APWR assumes a partition of 200, as suggested by Ref. 6 of the SRP for boric acid acid solution with trace impurities.	
SRP 6.5.2-1.e: A sump pH above 8.5 should be achieved at the beginning of the spray recirculation mode.	Credit for iodine retention by the sump solution is based on a partition coefficient of 200. The equilibrium pH of the sump solution will be adjusted to a value above 8.0, within the first 24 hours, to minimize chloride induced stress corrosion cracking of austenitic stainless steel components and to minimize c rosion of galvanized components and components coated with zinc based paints.	15.6.4, 6.5.2

TABLE 1.8-2

USNRC Regulatory Guides

RG No. 1.1 Rev. 0	NET POSITIVE SUCTION HEAD FOR EMERGENCY CORE COOLING AND CONTAINMENT HEAT REMOVAL SYSTEM PUMPS (NOVEMBER 2, 1970)
Module Reference Sections 5.4.7, 6.2.2, 6.3	The WAPWR meets the intent of Regulatory Guide 1.1 for providing adequate net positive suction head (NPSH) for emergency core cooling and containment heat removal systems pumps with the following alternatives: The vapor pressure of the water in the Emergency Water Storage Tank (EWST) is assumed to be equal to the containment pressure for the long term post-accident recirculation. The static head and suction line pressure drop is considered for the emergency core cooling system, in addition to assuming that the vapor pressure of the water in the EWST is equal to the containment pressure. The vapor pressure of the EWST water cannot exceed the containment total pressure; therefore, assuming they are equal gives the limiting low value of available NPSH.
RG No. 1.4 Rev. 2	ASSUMPTIONS USED FOR EVALUATING THE POTENTIAL RADIOLOGICAL CONSEQUENCES OF A LOSS-OF-COOLANT ACCIDENT FOR PRESSURIZED WATER REACTORS (JUNE 1974)
Module Reference Section 15.6.3	The guidance of this regulatory guide was followed in defining the assumptions used in evaluating the potential radiological consequences of a loss-of-coolant accident for the WAPWR.

TABLE 1.8-2 (Cont)

RG No. 1.26 Rev. 3	QUALITY GROUP CLASSIFICATION AND STANDARDS FOR WATER-, STEAM-, AND RADIOACTIVE-WASTE-CONTAINING COMPONENTS OF NUCLEAR POWER PLANTS (FEBRUARY 1976)
Module Reference Section 3.2.2	Quality group classifications and standards for water-, steam-, and radioactive-waste-containing components for the WAPWR meet the intent of Regulatory Guide 1.26 with the following alternatives: The safety class terminology of ANSI/ANS 51.1-1983 is used instead of the quality group terminology. Thus, the terms Safety Class 1, Safety Class 2, Safety Class 3, and Non-nuclear Safety (NNS) Class are used instead of Quality Groups A, B, C, and D, respectively, and are consistent with present nuclear industry practice. Paragraph NB-7153 of the ASME Code Section III requires that there be no valves between a code safety valve and its relief point unless special interlocks prevent shutoff without other protection capacity. Therefore, as an alternative to Paragraphs C.1.e and C.2.c, a single safety valve designed, manufactured, and tested in accordance with ASME III Division 1 is considered acceptable as the boundary between the reactor coolant pressure boundary and a lower safety class or NNS class line.

TABLE 1.8-2 (Cont)

Each component which is required to mitigate the consequences of an accident, as defined in ANSI/ANS 51.1, shall be classified Seismic Category I. In addition, all components classified as Safety Class 1, 2, or 3 shall be designated Seismic Category I. Seismic Category I components, structures, and systems shall be designed to remain functional in the event of the safe shutdown earthquake (SSE). All Seismic Category I components are designed and constructed to Quality Assurance (QA) Category I requirements.

Portions of structures, systems, and components which are not required for safety functions, but whose failures could affect safety-related components, shall be designed such that the SSE will not result in adverse effects on safety-related components.

Seismic Category I design requirements shall extend to the first seismic restraint beyond the seismic boundary and shall include the interface portion of the boundary itself (that is, for piping systems, the isolation valve at a boundary between Seismic Category I and nonseismic portions shall be designated Seismic Category I. The piping up to, and including, the first seismic restraint beyond the valve shall be designed to Seismic Category I requirements (but shall not be designated Seismic Category I). By this means, the Seismic Category I boundary is defined with respect to safety-related function, and the interfacing portions meet the seismic design requirements in order to ensure the integrity of the boundary.

TABLE 1.8-2 (Cont)

RG No. 1.31 Rev. 3	CONTROL OF FERRITE CONTENT IN STAINLESS STEEL WELD METAL (OCTOBER 1978)
Module Reference Section 6.1	Westinghouse Complies.
RG No. 1.36 Rev. 0	NONMETALLIC THERMAL INSULATION FOR AUSTENITIC STAINLESS STEEL (FEBRUARY 1973)
Module Reference Section 6.1	Westinghouse Complies.
RG No. 1.37 Rev. 0	QUALITY ASSURANCE REQUIREMENTS FOR CLEANING OF FLUID SYSTEMS AND ASSOCIATED COMPONENTS OF WATER-COOLED NUCLEAR POWER PLANTS (MARCH 1973)
Module Reference Section 6.1	The Quality Assurance Program is provided in WCAP-8370, Revision 9A.
RG No. 1.44 Rev. 0	CONTROL OF THE USE OF SENSITIZED STAINLESS STEEL (MAY 1973)
Module Reference Section 6.1	Westinghouse complies. The position and practice is discussed in the Reactor Coolant System Module.

TABLE 1.8-2 (Cont)

RG No. 1.54 Rev. 0	QUALITY ASSURANCE REQUIREMENTS FOR PROTECTIVE COATINGS APPLIED TO WATER-COOLED NUCLEAR POWER PLANTS (JUNE 1973)
Module Reference Section 6.1	Equipment located in the containment building is separated into four categories to identify the applicability of this regulatory guide to various types of equipment. These categories of equipment are as follows:

Category 1 - Large equipment
Category 2 - Intermediate equipment
Category 3 - Small equipment
Category 4 - Insulated/stainless steel equipment

A discussion of each equipment category follows:

a. Category 1 - Large Equipment

The Category 1 equipment consist of the following:

Reactor coolant system supports.
Reactor coolant pumps (motor and motor stand).
Accumulator tanks.
Manipulater crane.

TABLE 1.8-2 (Cont)

RG No. 1.54 (cont)

Since this equipment has a large surface area and is procured from only a few vendors, it is possible to implement tight controls over these items.

Stringent requirements have been specified for protective coatings on equipment through the use of a painting specification in our procurement documents. This specification defines requirements for:

1. Preparation of vendor procedures.

2. Use of specific coating systems which are qualified to ANSI N101.2.

3. Surface preparation.

4. Application of the coating systems in accordance with the paint manufacturer's instructions.

5. Inspections and nondestructive examinations.

6. Exclusion of certain materials.

7. Identification of all nonconformances.

8. Certifications of compliance.

The vendor's procedures are subject to review by engineering personnel, and the vendor's implementation of the specification requirements is monitored during the Westinghouse quality assurance surveillance activities.

TABLE 1.8-2 (Cont)

RG No. 1.54 (cont)

This system of controls provides assurance that the protective coatings will properly adhere to the base metal during prolonged exposure to a post-accident environment present with the containment building.

b. Category 2 - Intermediate Equipment

The Category 2 equipment consists of the following:

Seismic platform and tie rods.
Reactor internals lifting rig.
Head lifting rig.
Electrical cabinets.

Since these items are procured from a large number of vendors, and individually have very small surface areas, it is not practical to enforce the complete set of stringent requirements which are applied to Category 1 items. However, another specification has been implemented in the NSSS procurement documents. This specification defines to the vendors the requirements for:

1. Use of specific coating systems which are qualified to ANSI N 101.2.

2. Surface preparation.

3. Application of the coating systems in accordance with the paint manufacturer's instructions.

TABLE 1.8-2 (Cont)

RG No. 1.54 (cont)

The vendor's compliance with the requirements is also checked during the quality assurance surveillance activities in the vendor's plant. These measures of control provide a high degree of assurance that the protective coatings will adhere properly to the base metal and withstand the postulated accident environment within the containment building.

c. Category 3 - Small Equipment

Category 3 equipment consists of the following:

Transmitters
Alarm horns
Small instruments
Valves
Heat exchanger supports

These items are procured from several different vendors and are painted by the vendor in accordance with conventional industry practices. Because the total exposed surface area is very small, no further requirements are specified.

d. Category 4 - Insulated or Stainless Steel Equipment

Category 4 equipment consists of the following:

Steam generators - covered with blanket insulation.

Pressurizer - covered with blanket insulation.

TABLE 1.8-2 (Cont)

RG No. 1.54 (cont)	Reactor pressure vessel - covered with rigid reflective insulation. Reactor cooling piping - stainless steel. Reactor coolant pump casings - stainless steel. Since Category 4 equipment is insulated or is stainless steel, no painted surface areas are exposed within the containment. Therefore, this regulatory guide is not applicable for Category 4 equipment.

TABLE 1.8-2 (Cont)

RG No. 1.70 Rev. 3	STANDARD FORMAT AND CONTENT OF SAFETY ANALYSIS REPORTS FOR NUCLEAR POWER PLANTS (NOVEMBER 1978)
Module Reference Section 1.1	The format and content of the WAPWR PSSS Module meets the intent of this regulatory guide.
RG No. 1.79 Rev. 1	PREOPERATIONAL TESTING OF EMERGENCY CORE COOLING SYSTEMS FOR PRESSURIZED WATER REACTORS (SEPTEMBER 1975)
Module Reference Section 6.3	Westinghouse complies. The ISS full flow testing capability combined with the in-containment EWST provides the capability to fully test the ECCS flow path from the containment, through the major portion of the high and low head pump subsystem not only during pre-operational testing but also during plant power operation or refueling.

TABLE 1.8-2 (Cont)

RG No. 1.82 Rev. 0	SUMPS FOR EMERGENCY CORE COOLING AND CONTAINMENT SPRAY SYSTEMS (JUNE 1974)
Module Reference Section 6.2.2	There are four independent and physically separated sump pits provided in the in-containment EWST. Each of these four EWST sump pits are assigned to a separate ISS subsystem, the suction piping for one ISS high head pump and one ISS low head pump is connected to its individual EWST sump pit. The EWST and the four EWST pump pits meet the intent of this regulatory guide. Large area vertical trash racks and fine screens are provided for each of the four EWST sump pits. The EWST and EWST sump pits are located in the containment base mat and constructed of stainless steel liner plates. A minimum water level will be maintained in the EWST during any postulated LOCA to insure adequate NPSH, low screen approach velocities, and no vortexing.

TABLE 1.8-2 (Cont)

RG No. 1.139 Rev. 0	GUIDANCE FOR RESIDUAL HEAT REMOVAL (MAY 1978)
Module Reference Section 5.4.7	The safe shutdown basis for the WAPWR is hot standby and cold shutdown which meets Regulatory Guide 1.139 and the Branch Technical Position RSB-1 5-1 design guidelines for Class 2 plants with the following clarifications: Following a safe shutdown earthquake, assuming loss of onsite or offsite power and the most limiting single failure, the plant is capable of achieving cold shutdown conditions (approximately 200°F and 400 psia) within 36 hours using only safety grade equipment. It should be recognized that non-safety systems are used during normal cooldowns and provide desirable operating capabilities.