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DCP/NRC1039
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Docket No.: 52-003

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Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: T. R. QUAY

SUBJECT: AP600 SSAR MARKUP FOR THE CONTAINMENT SPRAY SYSTEM DESIGN

Dear Mr. Quay:

At the August 7, 1997, meeting between representatives of the Nuclear Regulatory Commission (NRC) and Westinghouse, Westinghouse agreed to document the design of the Containment Spray System in the AP600 SSAR. Please find attached, a markup of the AP600 SSAR that reflects the design of the Containment Spray System. Changes to the Fire Protection System reflect only the addition of the Containment Spray System. Additional Fire Protection System changes will not affect the representation of the Containment Spray System. The changes identified in this markup will be incorporated into revision 17 of the SSAR.

If you have any questions on this material, please call Susan Fanto at (412) 374-4028.

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

jml

Attachment
Enclosure

cc: N. J. Liparulo, Westinghouse (w/o Attachment)
T. J. Kenyon, NRC (w/ Attachment)

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ATTACHMENT TO DCP/NRC1039

SSAR Section 1.9.5

C-5 **Decay Heat Update**

Discussion:

Generic Issue C-5 involves following the work of research groups in determining best-estimate decay heat data and associated uncertainties for use in LOCA calculations.

The staff has determined that the 1979 ANSI 5.1 is technically acceptable and has allowed the use of this data to justify relaxation of non-required conservatisms in current ECCS evaluation models. The ECCS rule change allows the use of this new data. This issue was determined to be resolved.

AP600 Response:

The large-break LOCA analyses for the AP600, which employ the best-estimate W COBRA/TRAC analysis methodology (subsection 15.6.5), use the decay heat model identified in the 1979 ANSI 5.1 (Reference 26).

C-6 **LOCA Heat Sources**

Discussion:

Generic Issue C-6 addresses the impact on LOCA calculations of LOCA heat sources, their associated uncertainties, and the manner in which they are combined. An evaluation was made of the combined effect of power density, decay heat, stored energy, fission power decay, and their associated uncertainties with regard to calculations of LOCA heat sources.

AP600 Response:

See subsection 15.6.5 for a discussion of LOCA heat sources.

C-10 **Effective Operation of Containment Sprays in a LOCA**

Discussion:

Generic Issue C-10 addresses the effectiveness of containment sprays to remove airborne radioactive materials that could be present within the containment following a LOCA. The NRC considers this issue as being technically resolved with the issuance of ANSI 56.5-1979 (Reference 28), which is referenced in Standard Review Plan, Section 6.5.2.

AP600 Response:

The AP600 design does not employ a safety-related containment spray system for removal of airborne radioactive materials in containment. Ssubsection 15.6.5.3 provides details of source term and mitigation techniques.

C-17 Interim Acceptance Criteria for Solidification Agents for Radioactive Solid Wastes

Discussion:

Generic Issue C-17 addresses the development of criteria for acceptability of radwaste solidification agents. The NRC considers this issue as technically resolved with the issuance of 10 CFR 61.56.

AP600 Response:

The AP600 solid radwaste system transfers, stores, and prepares spent ion exchange resins for disposal. It also provides for disposal of filter elements; sorting, shredding, and compaction of compressible dry active wastes. The solid radwaste system does not provide for liquid waste concentration or solidification. These functions, if used, are provided using mobile systems. Solidification of wastes is not performed by permanently installed systems.

1.9.4.2.3 New Generic Issues

These items were identified in NUREG-0933 as New Generic Issues and surfaced after the publication of the NUREGs that included the Task Action Plan items other unresolved safety issues.

Issue 14 PWR Pipe Cracks

Discussion:

This issue addresses the occurrences of main feedwater line cracking found in operating plants. This issue was classified as resolved with no new requirements.

AP600 Response:

The design and inspection requirements for the feedwater lines are discussed in subsection 10.4.7.

1.9.5.2.5 Classification of Main Steamline of Boiling Water Reactors (BWRs)

This issue is specific to BWRs and therefore does not apply to the AP600 design.

1.9.5.2.6 Tornado Design Basis

NRC Position:

WASH-1300 (Reference 43) and Regulatory Guide 1.76 contain the current NRC regulatory position for design basis tornados. Based on a contractor review of Regulatory Guide 1.76, the NRC recommends a maximum tornado speed of 300 mph be used for design basis tornado for passive ALWR designs.

The tornado design basis requirements have been used in establishing structural requirements against effects not covered explicitly in review guidance such as Regulatory Guides or the SRP. The Combined License applicant will have to demonstrate that the design will also be sufficient to withstand other site hazards such as aviation crashes, nearby explosions, and explosion debris and missiles.

AP600 Response:

The AP600 is designed in accordance with the NRC recommendations for a maximum tornado wind speed of 300 mph, as described in Section 3.3. The AP600 site interface defined in Chapter 2 provides that the Combined License applicant evaluate other site hazards if appropriate.

1.9.5.2.7 Containment Bypass

NRC Position:

Reasonable efforts should be made to minimize the possibility of containment bypass leakage, and ALWR designs should allow for a certain amount of leakage in the containment design. The NRC is evaluating the need for containment spray for all ALWRs. The containment spray provides containment temperature and pressure suppression effects and scrubs the containment atmosphere of fission products, mitigating the effects on the fission product bypass distribution.

AP600 Response:

Although the phenomenon described for this item is primarily applicable to BWRs, the AP600 has a variety of design features that help to reduce the potential for containment bypass leakage.

The response to the containment performance issue in subsection 1.9.5 provides additional information pertaining to various improvements that help to reduce containment bypass.

The safety-related passive containment cooling system design also contributes to the containment performance. The system includes multiple flow paths to provide cooling water for containment during severe accident conditions. The containment is also capable of successfully removing core decay heat with air-cooling alone.

The containment has a significantly reduced number of penetrations. The number of normally open containment penetrations is also reduced. The result is a low containment leak rate and a low probability of bypass.

The response to intersystem LOCA in subsection 1.9.5.1 provides additional information pertaining to applicable AP600 design features that reduce the potential for intersystem LOCA and the potential for containment bypass.

Improvements are made to the steam generator design, such as the use of improved tube materials and tube supports. These improvements reduce the potential for tube leakage, which contributes to a reduction in containment bypass. Subsection 5.4.2 provides additional information on the steam generator design.

During a steam generator tube rupture event, the safety-related passive core cooling system automatically mitigates the effects of the event, including automatic safety-related protection against steam generator overfill.

The safety-related passive core cooling system provides long-term pH control for the containment sump, which helps to reduce the levels of airborne radioactivity, thereby reducing the consequences of leakage from the containment. Section 6.3 includes additional information on the passive core cooling system.

The diverse actuation system includes containment isolation features to provide isolation for the most risk-significant containment penetrations. PRA Chapter 24 discusses the provisions for isolating risk significant containment penetrations.

The performance of the passive fission product removal process and minimal potential for containment bypass precludes the need for a safety-related containment spray system on AP600.

1.9.5.2.8 Containment Leak Rate Testing

NRC Position:

SECY-91-348 (Reference 44) proposes changes to 10 CFR 50, Appendix J to allow an increased interval from 24 months to 30 months for Type C containment leakage rate tests, until rule change proceedings are completed.

the acceptability of using active, nonsafety-related systems to take a plant to cold shutdown conditions.

AP600 Response:

The AP600 includes safety-related passive systems and equipment that are designed to automatically establish and indefinitely maintain safe shutdown conditions for the plant following design basis events.

Sections 6.3 and 7.4 provide additional information pertaining to safe shutdown, using the safety-related passive systems.

1.9.5.3.5 Control Room Habitability

NRC Position:

10 CFR 50, Appendix A, GDC 19 requires adequate radiation protection to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of five rem whole body, or its equivalent, to any part of the body, for the duration of the accident. Section 6.4 of the Standard Review Plan defines this dose criterion in terms of specific whole-body and organ doses (5 rem to whole body, and 30 rem each to thyroid and skin). The NRC requires that the analyses of main control room habitability be based on the dose criterion defined in GDC 19 of Appendix A to 10 CFR 50 and Section 6.4 of the Standard Review Plan (5 rem to whole body, and 30 rem each to thyroid and skin). In addition, the analyses of control room habitability should be based on the duration of the accident according to GDC 19 of Appendix A to 10 CFR 50.

AP600 Response:

The AP600 design includes a passive, safety-related main control room habitability system to meet the requirements of GDC 19 and Section 6.4 of the Standard Review Plan. Section 6.4 provides additional information.

As described in subsection 15.6.5.3, the main control room operator doses following a design basis loss of coolant accident are within the dose criterion of the Standard Review Plan, Section 6.4.

1.9.5.3.6 Radionuclide Attenuation

NRC Position:

The NRC is concerned that use of the auxiliary building for holdup may require additional restrictions to be placed on the auxiliary building during normal operation. In addition, the

NRC is continuing its evaluation of the need for a containment spray system for passive plant designs.

AP600 Response:

The AP600 design does not have a safety-related containment spray or take credit for auxiliary building holdup for mitigation of the design basis loss of coolant accident. The design includes a low-leakage-rate containment (0.12 percent per day) together with credit for aerosol removal by naturally occurring processes and pool scrubbing in containment. The low-leakage containment and natural aerosol removal are adequate to meet 10 CFR 100 dose limits, consistent with the physically-based source term.

1.9.5.3.7 Simplification of Off-Site Emergency Planning

NRC Position:

The NRC states that changes to emergency planning regulatory requirements may be appropriate, but that an NRC determination on this issue will require detailed design evaluation. Summaries of specific NRC conclusions are as follows:

- Unique characteristics of the designs should be considered in determining the extent of emergency planning, including the ability to prevent significant release of radioactive material or to provide delay times for all but the most unlikely events.

- A very low likelihood of all containment bypass sequences will be required before relaxing emergency planning requirements.

- Lack of information on source term and risk precludes further NRC evaluation of emergency preparedness for the passive plants at this time.

- Emergency planning requirements following the TMI-2 accident were not premised on specific assumptions regarding severe accident probability. So, as a policy matter, even very low calculated probabilities may not be a sufficient basis for changes to emergency planning requirements.

The industry and the NRC are working to determine a process, including developing technical criteria and methods, that would justify simplification of offsite emergency planning. The results of this process would be used as input to a generic rulemaking proposal to be initiated by nuclear industry organizations.

AP600 Response:

The AP600 PRA evaluation risk assessment includes calculations of the AP600 response to severe accidents. This response includes the release of radionuclides following a severe accident. This analysis supports the technical basis for simplification of offsite emergency planning. The offsite emergency planning is the responsibility of the Combined License applicant.

SSAR Appendix 1B

- assuming appropriate timing, containment spray could be used as an alternate means for flooding the reactor vessel (in-vessel retention) and for debris quenching should vessel failure occur,

- containment spray could also be used to control containment pressure for cases in which PCS has failed.

In order to envelop these potential risk benefits, the risk reduction evaluation will assume that containment sprays are perfectly effective for each of these benefits, with the exception of fission product scrubbing for containment bypass. Thus the risk reduction can be conservatively estimated by assuming all release categories except BP are eliminated. Therefore, passive containment spray results in a total averted risk of 6.9×10^{-3} man-rem per year.

~~Additionally, a nonsafety-related containment spray system is evaluated. The nonsafety-related containment spray system utilizes the fire protection pumps as a motive force for spray, less remotely operated valves but approximately the same amount of piping. It will be conservatively assumed that the risk benefits are the same, and that the risk reduction remains the same for the nonsafety-related containment spray system. Thus, the nonsafety-related containment spray system results in a total averted risk of 6.9×10^{-4} man-rem per year.~~

1B.7.6 Active High Pressure Safety Injection System

This SAMDA consists of adding a safety-related active high pressure safety injection (HPSI) pump and all associated piping and support systems to the AP600 design. A perfect high pressure safety injection system is assumed to prevent core melt for all events but excessive LOCA and ATWS. Therefore, to estimate the risk reduction, only the contributions to each release category of Level 1 accident classes 3C (vessel rupture) and 3A (ATWS) need be considered. The averted risk is 6.1×10^{-3} man-rem per year. This SAMDA would completely change the design approach from a plant with passive safety systems to a plant with passive plus active safety-related systems and is not consistent with design objectives.

1B.7.7 Steam Generator Shell-Side Heat Removal System

This SAMDA consists of providing a passive safety-related heat removal system to the secondary side of the steam generators. The system would provide closed loop cooling of the secondary using natural circulation and stored water cooling, thus preventing a loss of primary heat sink in the event of a loss of startup feedwater and passive RHR heat exchanger. A perfect secondary heat removal system would eliminate transients from each of the release categories. In order to evaluate the benefit of this SAMDA, the frequencies of all the transient sequences is subtracted from the overall frequency of each of the release categories and the risk is recalculated. The total risk averted is 5.3×10^{-4} man-rem per year.

Table 1B.8-1

AP600 SAMDA RESULTS

Design Alternative	Risk Reduction (manrem/yr)	Capital Benefit ($)	Capital Cost ($)	Net Capital Benefit ($)
Upgrade CVS for Small LOCA	5.5×10^{-4}	4	1,500,000	(1,500,000)
Containment Filtered Vent	1.0×10^{-3}	6	5,000,000	(5,000,000)
Self-Actuating Containment Isolation Valves	7.4×10^{-4}	5	33,000	(33,000)
Safety Grade Passive Containment Spray	6.9×10^{-3}	44	3,900,000	(3,900,000)
~~Non-Safety-Grade Containment Spray~~	~~6.9×10^{-3}~~	~~44~~	~~415,000~~	~~(415,000)~~
Active High Pressure Safety Injection System	6.1×10^{-3}	39	20,000,000	(20,000,000)
SG Shell Side Heat Removal	5.3×10^{-4}	3	1,300,000	(1,300,000)
SG Relief Flow to IRWST	4.2×10^{-4}	3	620,000	(620,000)
Increased SG Pressure Capability	4.2×10^{-4}	3	8,200,000	(8,200,000)
Secondary Containment Ventilation with Filtration	7.4×10^{-4}	5	2,200,000	(2,200,000)
Diverse IRWST Injection Valves	5.3×10^{-3}	34	160,000	(160,000)
Diverse Containment Recirculation Valves	1.5×10^{-4}	<1	150,000	(150,000)
Ex-Vessel Core Catcher	6.1×10^{-3}	39	1,660,000	(1,660,000)
High Pressure Containment Design	6.1×10^{-3}	39	50,000,000	(50,000,000)
More Reliable DAS	2.2×10^{-4}	2	470,000	(470,000)

SSAR Section 6.5

6.5 Fission Product Removal and Control Systems

6.5.1 Engineered Safety Feature (ESF) Filter Systems

This subsection is not applicable to the AP600.

6.5.2 Containment Spray System

~~In the event of a core degradation accident there could be a significant quantity of radioactivity released to the containment atmosphere. This activity would consist of noble gases, particulates, and a small amount of elemental and organic iodine (as discussed in subsection 15.6.5.3, most of the iodine would be in the particulate form). The AP600 does not include a containment spray system to remove airborne particulates or elemental iodine. Removal of airborne activity is by natural processes that do not depend on sprays (that is, sedimentation, diffusiophoresis, and thermophoresis). These removal mechanisms are discussed in Appendix 15B.~~

In the event of a design basis LOCA there is an assumed core degradation that results in a significant release of radioactivity to the containment atmosphere. This activity would consist of noble gases, particulates, and a small amount of elemental and organic iodine (as discussed in subsection 15.6.5.3, most of the iodine would be in the particulate form). The AP600 does not include a safety-related containment spray system to remove airborne particulates or elemental iodine. Removal of airborne activity is by natural processes that do not depend on sprays (that is sedimentation, diffusiophoresis, and thermophoresis). These removal mechanisms are discussed in Appendix 15B.

Much of the non-gaseous airborne activity would eventually be deposited in the containment sump solution. Long-term retention of iodine in the containment sump following design basis accidents requires adjustment of the sump solution pH to 7.0 or above. This pH adjustment is accomplished by the passive core cooling system and is discussed in subsection 6.3.2.1.4.

In accordance with Reference 1, the fire protection system provides a nonsafety-related containment spray function for accident management following a severe accident. This design feature is not safety-related and is not credited in any accident analysis including the dose analysis provided in section 15.6.5. Dose reduction following a severe accident may be enhanced over the natural removal mechanisms via the nonsafety-related containment spray. Subsection 15.6.5.3.2 provides additional discussion of the natural removal mechanisms. The following subsections provide a discussion of the nonsafety-related containment spray function provided by the fire protection system.

6.5.2.1 System Description

The fire protection system provides a nonsafety-related containment spray function for severe accident management. Subsection 9.5.1 provides a description of the fire protection system including equipment and valves that support the containment spray function such as the fire

pumps and fire main header. This section provides the description of the portion of the fire protection system designed specifically to provide the containment spray function.

The source of water for the containment spray function is provided by either the primary or secondary fire protection system water tank depending on tank and inventory availability. Either the motor driven or diesel driven fire protection system pump may be used to deliver fire water to the containment spray header. The flow path to containment is via the normal fire main header as shown in Figure 9.5.1-1, sheets 1 through 3. The containment spray flow path is from the fire main extension, through the fire protection system line that penetrates containment to the containment spray riser that connects to the fire protection system header inside containment. This riser supplies two ring headers located above the containment polar crane.

6.5.2.1.1 Valves

The containment spray flow path from the fire main header contains two normally open manual valves (FPS-V101 and FPS-V048), one normally closed manual valve (PCS-V007), one lock closed manual containment isolation valve outside containment (PCS-V050), a containment isolation check valve inside containment (FPS-V052), a normally open manual isolation valve in the spray riser (FPS-V700), and a normally closed remotely-operated valve (FPS-V701) downstream of the manual isolation valve in the spray riser.

Containment spray is initiated by first opening the manual valves outside containment, and by opening the remotely-operated valve inside containment. The manual valves outside containment are located in valve / piping penetration room 12306. The valves are located close to the entrance door such that radiation exposures to an individual required to enter the room and align the valves would not exceed the prescribed post-accident dose limits discussed in subsection 12.4.1.8.

Valve FPS-V701 is a fail-open air-operated valve such that the containment spray flow path it can be opened following a loss of the nonsafety-related compressed air system. During shutdown operations, the fire protection system header inside containment is pressurized from the passive containment cooling water storage tank for fire protection and manual isolation valve FPS-V700 is closed.

6.5.2.1.2 Containment Spray Header and Nozzles

The containment spray header consists of a single header that feeds two ring headers located above the containment polar crane. The containment spray ring headers and spray nozzles are oriented to maximize containment volume coverage. A lower ring header is located at plant elevation 235 feet, and contains 44 spray nozzles. An upper ring header is located at plant elevation 250 feet, and contains 24 spray nozzles.

The nozzles within the spray ring header are conventional containment spray nozzles utilized in past Westinghouse pressurized water reactors. The spray nozzles are selected on the basis

of drop size to provide adequate absorption of fission products from the containment atmosphere.

6.5.2.1.3 Applicable Codes and Classifications

The containment spray function is not safety-related, and therefore the valves and piping in the containment spray flow path are not required to be safety-related for the containment spray function. However, the containment isolation piping and valves are safety-related (AP600 Equipment Class B) to perform the safety-related function of containment isolation. The classification of the remaining portions of the fire header are nonsafety-related, and are classified as Class F as discussed in subsections 3.2.2.7 and 9.5.1. The containment spray header and valve, downstream of the manual isolation valve inside containment is nonsafety-related and classified as Class E. The containment spray header is classified as Seismic category II.

6.5.2.1.4 System Operation

During normal operation, the fire protection system header inside containment is isolated from the fire main header. The containment spray piping is therefore not pressurized during normal operation. During plant shutdown modes, personnel access to containment is required, and as such, the fire protection system standby header inside containment is pressurized by the water in the passive containment cooling water storage tank. During these modes, manual isolation valve FPS-V700 is closed to further isolate the containment spray header from the passive containment cooling water storage tank.

Severe accident management guidelines provide the operator with guidance to initiate the containment spray feature of the fire protection system. Operator action to open two manual isolation valves outside of containment followed by remotely opening the containment spray isolation valve within containment from either the main control room or the remote shutdown workstation will initiate the spray function. Containment spray may be terminated at any time by closing the remotely operated isolation valve within containment, or by closing any of the manual valves in the containment spray flow path outside containment. Operation of the containment spray will have no effect on the availability of the remainder of the fire protection system other than the loss of inventory due to the sprayed water. Since the fire protection system operates in the active standby mode, i.e. the supply piping is kept full and pressurized, once the remotely operated isolation valve is opened the system will perform the containment spray function.

When water pressure in the fire main begins to fall, due to a demand for water from containment spray, the motor-driven pump starts automatically on a low-pressure signal. If the motor-driven pump fails to start, the diesel-driven pump starts upon a lower pressure signal. The pump continues to run until it is stopped manually.

6.5.2.2 Design Evaluation

6.5.2.2.1 Containment Coverage

The containment spray nozzles are the Lechler (SPRACO Company, spray nozzles or equivalent, which provide a drop size distribution which has been established by testing and found suitable for fission product removal. The fire protection system header provides a containment spray nozzle differential pressure of 40 psid, which fixes the drop size distribution. The mass mean drop size produced at this differential pressure is conservatively assumed to be 1000 microns.

The fire protection system header can provide the design flow rate of 15.2 gpm to each spray nozzle at a containment backpressure of 20 psig for a total containment spray flow of approximately 1034 gpm. Analyses of severe accident sequences show that containment backpressure is less than 20 psig after containment spray flow is initiated.

Figure 6.5-1 is a diagram of containment which shows the developed spray patterns for the containment spray ring headers. The overlay of the spray patterns on the containment is useful in illustrating the completeness of spray coverage in the sprayed region. Furthermore, as discussed in reference 2, there is significant momentum exchange between the spray droplets and the closed air volume of the containment, which provides far greater mixing within the sprayed region than the idealized spray patterns would indicate. Therefore, even though small areas of the sprayed region are not directly sprayed by the developed spray patterns, the sprayed region of the containment is well-mixed.

The sprayed regions of containment include the region of containment above the operating deck, and the refueling cavity, which is open at the operating deck. The total free volume of the sprayed region is approximately 1.4×10^6 cubic feet which represents approximately 83% of the total containment free volume.

6.5.2.2.2 Aerosol Removal Effectiveness of Sprays

The removal of aerosol activity from the containment atmosphere by sprays is simply described by:

$$C_t = C_o e^{-\lambda t}$$

where:

C_t = concentration of aerosols at time "t"

C_o = initial concentration of aerosols

λ = aerosol removal coefficient for sprays (hr^{-1})

t = elapsed time (hr)

However, to fully model the removal of aerosols from the containment atmosphere in a severe accident, the analysis also needs to take into account mixing between the sprayed and unsprayed regions and the rate of release of activity from the core into the containment atmosphere.

6.5.2.2.3 Aerosol Removal Coefficient for Sprays

The aerosol removal coefficient for sprays is calculated by the following equation from the Standard Review Plan (Reference 3):

$$\lambda = 3hfE / 2Vd$$

where:

h = average spray drop fall height (ft)

f = spray flow rate (ft^3/hr)

E = collection efficiency

V = volume of the containment exposed to sprays

d = average spray drop diameter (ft)

Reference 3 identifies a value for E/d of 0.305 ft^{-1} as being conservative. Using this together with a nominal spray fall height of 100 feet and a nominal flow rate of 1000 gpm (8022 ft^3/hr), the aerosol removal coefficient for the containment sprays is approximately 2.6 hr^{-1} in the sprayed volume. This spray removal coefficient is significantly greater than that associated with the natural removal mechanisms assumed in the design basis analysis (see Appendix 15B) and would enhance dose reduction following a severe accident.

6.5.3 Fission Product Control Systems

The containment atmosphere is depleted of elemental iodine and particulates as a result of the passive removal processes discussed in SSAR Appendix 15B. No active fission product control systems are required in the AP600 design to meet regulatory requirements. The passive removal processes and the limited leakage from the containment of less than L_a as defined in the Containment Leakage Rate Testing Program, result in doses less than the regulatory guideline limits. (See subsection 15.6.5.3.)

6.5.3.1 Primary Containment

The containment consists of a freestanding cylindrical steel vessel with ellipsoidal heads. The containment structural design is presented in subsection 3.8.2.

The containment vessel, penetrations, and isolation valves function to limit the release of radioactive materials following postulated accidents. The resulting offsite doses are less than regulatory guideline limits. Containment parameters affecting fission product release accident analyses are given in Table 6.5.3-1.

Long-term containment pressure and temperature response to the design basis accident are presented in Section 6.2.

The containment air filtration system may be operated for personnel access to the containment when the reactor is at power, as presented in subsection 9.4.7. For this reason, the radiological assessment of a loss-of-coolant accident assumes that both trains of the air filtration system are in service at the initiation of the event. The isolation valves receive automatic signals to close from diverse parameters. The valves are designed to close automatically as described in subsection 6.2.3.

Containment hydrogen control systems are presented in subsection 6.2.4.

6.5.3.2 Secondary Containment

There is no secondary containment provided for the fission product control following design basis accident.

The annulus between containment and shield building from the elevation 100'-0" to the elevation 132'-3" acts as a holdup volume to limit the spread of fission products following severe accident. Most containment penetrations are located within this holdup volume. It is served by the radiologically controlled area ventilation system (VAS) described in subsection 9.4.3. Isolation dampers are provided to reduce the air interchange between the holdup volume and environment. Fission product control via holdup within the annulus is considered in severe accident dose analysis but excluded from consideration for design basis accident dose evaluations presented in Chapter 15.

6.5.4 Combined License Information

This section has no requirement for additional information to be provided in support of the Combined License applications.

6.5.5 References

1. SECY-97-044, "Policy and Key Technical Issues Pertaining to the Westinghouse AP600 Standardized Passive Reactor Design," June 30, 1997.

2. "Licensing Design Basis Source Term Update for the Evolutionary Advanced Light Water Reactor," Advanced Reactor Severe Accident Program (ARSAP) Source Term Expert Group, September, 1990.

3. NUREG-0800, Section 6.5.2, Revision 2, "Containment Spray as a Fission Product Cleanup System."

Table 6.5.3-1

PRIMARY CONTAINMENT OPERATION FOLLOWING A DESIGN BASIS ACCIDENT

Type of structure	Freestanding cylindrical steel vessel with ellipsoidal heads
Containment free volume (ft^3)	1.73×10^6
Design Basis Containment leak rate	0.12% containment volume per day

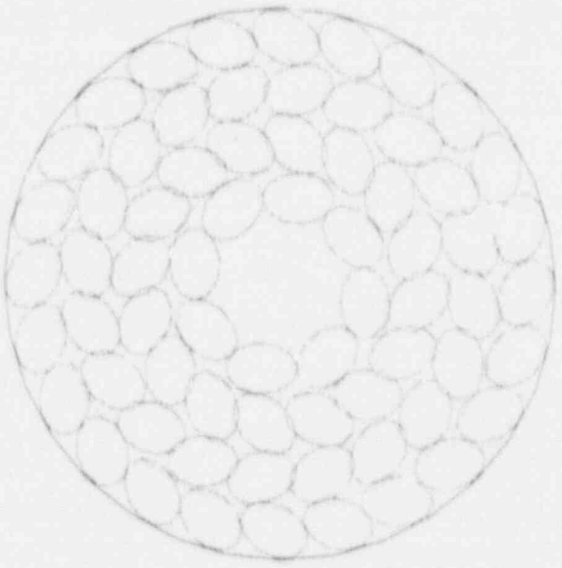


Figure 6.5-1

Containment Spray Coverage At the Operating Deck

SSAR Section 9.5.1

9.5.1.1.3 Nonsafety-Related Containment Spray Function

The fire protection system provides a nonsafety-related containment spray function. This function is discussed in subsection 6.5.2.

9.5.1.2 System Description

9.5.1.2.1 General Description

The fire protection program and the design of the fire protection system conform to the applicable codes and standards listed in Section 3.2, and the following:

- 10 CFR 50.48, Fire Protection (Reference 15)
- General Design Criterion 3, Fire Protection (Reference 16)
- SECY-93-087, Section I.E., Fire Protection (Reference 17)

Table 9.5.1-1 is a point-by-point description of the conformance of the fire protection program with the guidelines of Branch Technical Position (BTP) CMEB 9.5-1 (Reference 1). AP600 meets the enhanced fire protection provisions of SECY-93-087 as demonstrated in the fire protection analysis (Appendix 9A).

The plant includes features to minimize the likelihood that a fire will occur and to limit the spread of fire.

The fire protection system detects fires and provides the capability to extinguish them using fixed automatic and manual suppression systems, manual hose streams, and/or portable firefighting equipment. The fire protection system consists of a number of fire detection and suppression subsystems, referred to as systems, including:

- Detection systems for early detection and notification of a fire
- A water supply system including the fire pumps, yard main, and interior distribution piping
- Fixed automatic fire suppression systems
- Manual fire suppression systems and equipment, including hydrants, standpipes, hose stations and portable fire extinguishers

The fire detection and suppression systems are described later in this subsection.

Table 9.5.1-2

COMPONENT DATA - FIRE PROTECTION SYSTEM (NOMINAL VALUES)

Fire Water Storage Tanks

Primary Fire Water Tank

Nominal capacity (gal)	325,000
Volume dedicated to fire protection (gal)	300,000
Design Pressure	Atmospheric
Material	Carbon steel

Secondary Fire Water Tank

Nominal capacity (gal)	400,000
Volume dedicated to fire protection (gal)	300,000
Design Pressure	Atmospheric
Material	Carbon steel

Fire Pumps

Motor-Driven

Pump type	Horizontal centrifugal
Rated flow (gpm)	2000
Required head, approximate (ft)	300
Structural material	Cast iron

Diesel-Driven

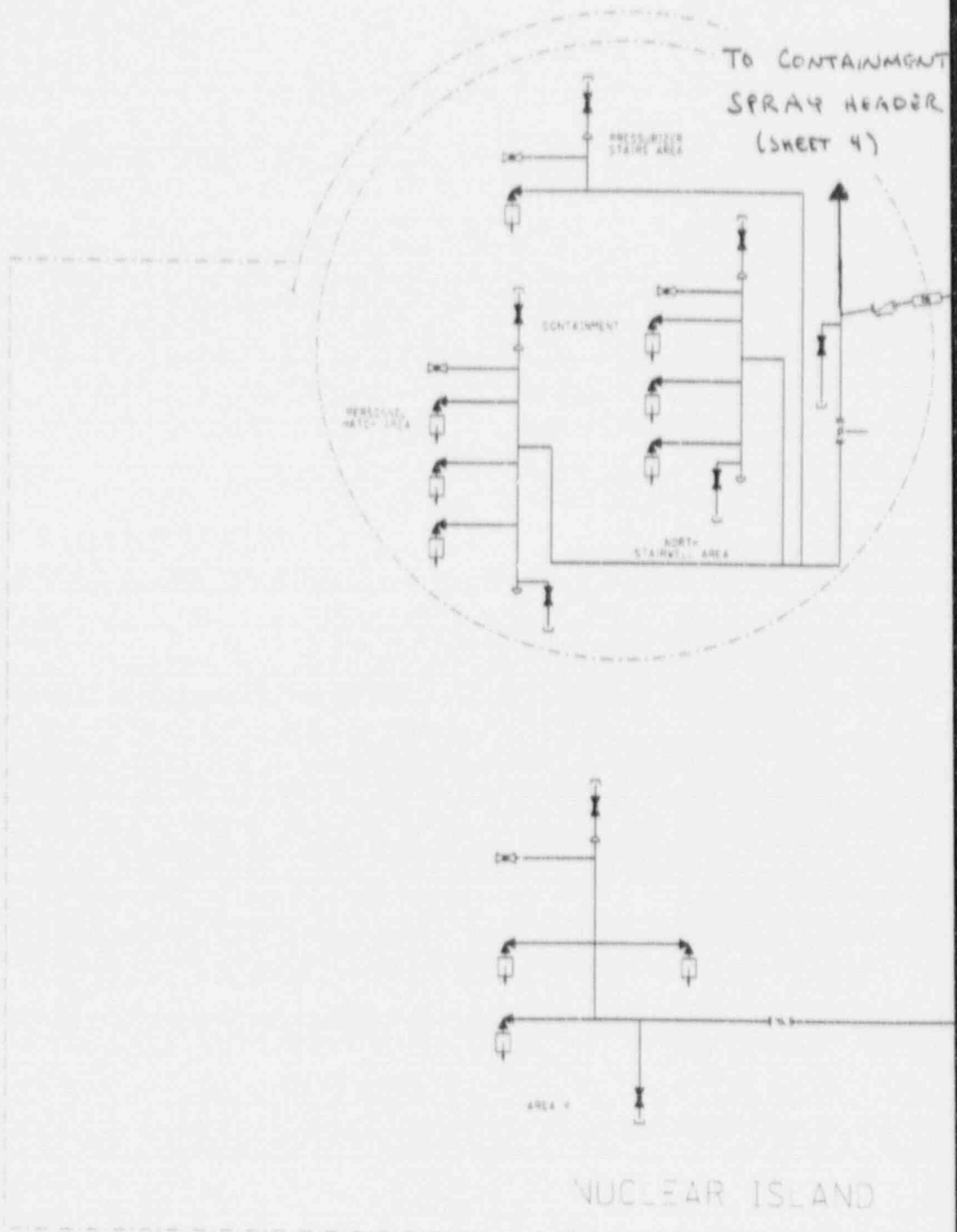
Pump type	Horizontal centrifugal
Rated flow (gpm)	2000
Required head, approximate (ft)	300
Structural material	Cast iron

Motor-Driven Jockey Pump

Pump type	Centrifugal
Rated flow (gpm)	30
Required head, approximate (ft)	210
Structural material	Cast iron

Containment Spray Nozzles

Type	Lechler (SPRACO) 1713A
Number	68
Rated flow (gpm)	15.2
Rated pressure design (psi)	40
Structural material	Stainless steel


TO CONTAINMENT
SPRAY HEADER
(SHEET 4)
CONTAINMENT
NUCLEAR ISLAND

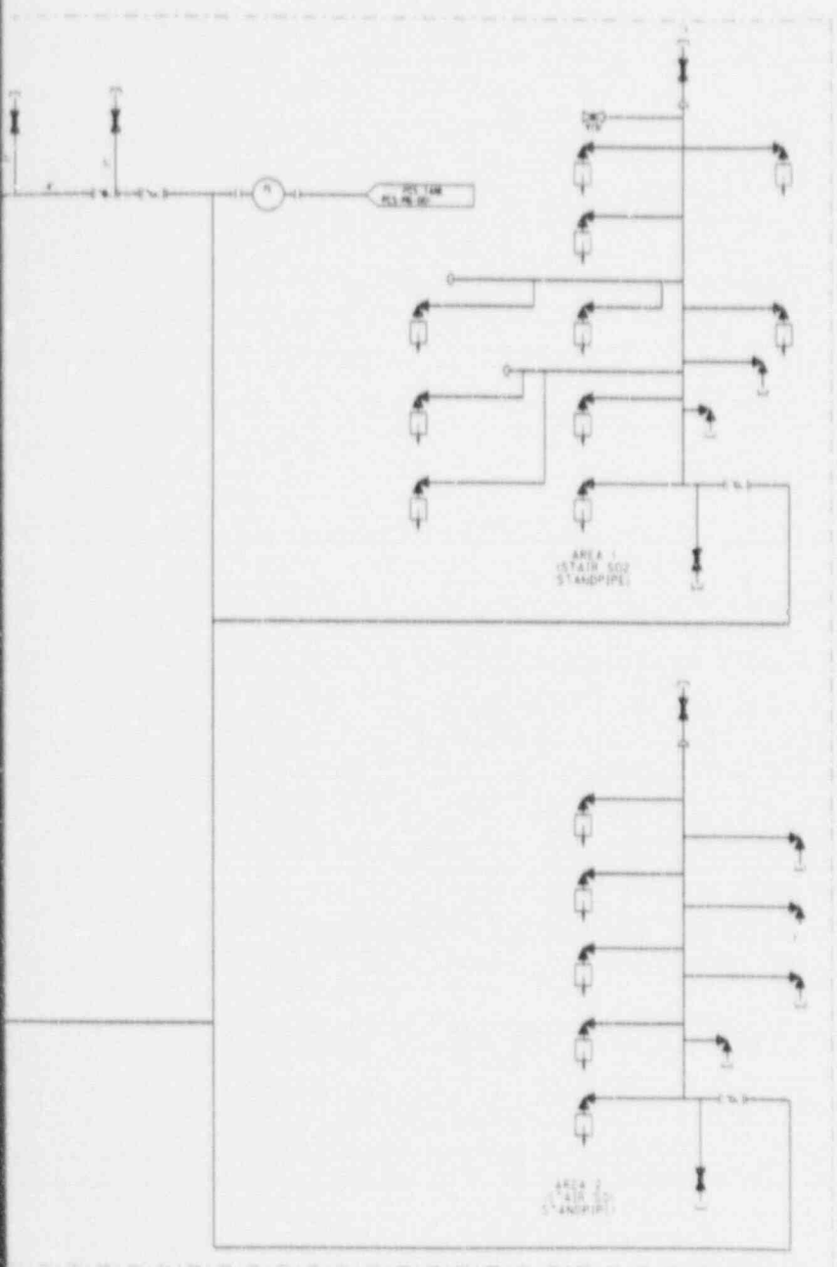


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Figure 9.5.1-1 (Sheet 3 of 4)

Fire Protection System
Piping and Instrumentation Diagram

(REF) FPS 004

9709230302-01

NOTE 1 - VALVE IS CLOSED DURING SHUTDOWN MODES WHEN FPS HEADER IRC IS PRESSURIZED

Figure 9.5.1-1 (Sheet 4 of 4)

Fire Protection System
Piping and Instrumentation Diagram
(REF FPS-001)

SSAR Section 14.2.9.2.8

e) The proper operation of the spent fuel pool siphon breakers is verified.

f) The proper operation of the spent fuel pool post-72 hour gravity drain flowpaths from the cask washdown pit and the passive containment cooling water storage tank is verified.

14.2.9.2.8 Fire Protection System Testing

Purpose

The purpose of the fire protection system testing is to verify the system properly performs the following defense-in-depth function as described in subsection 9.5.1:

- Provide equipment for manual fire fighting in areas containing safe shutdown equipment

Provide a nonsafety-related containment spray to reduce offsite dose following a severe accident

Prerequisites

The construction tests of the fire protection system have been completed. Required preoperational testing of the ac power and distribution systems and other interfacing systems required for operation of the fire protection system. Data collection is available as needed to support the specified testing and system configurations.

General Test Method and Acceptance Criteria

Fire protection system performance is observed and recorded during a series of individual component and integrated system testing to verify the system performs its defense-in-depth function. The following testing demonstrates that the system performs its defense-in-depth functions specified in subsection 9.5.1 and as specified in appropriate design specifications:

a) The capability of the seismic standpipes to supply the required fire water quantity and flow rate is verified.

b) The operability of the fire detection equipment is verified to be able to properly detect fires and alert personnel.

c) The proper installation and operation of fire barriers, fire walls, and fire dampers is verified.

d) The proper operation of the fire pumps, fire water storage tank, and fire water supply piping, valves, and instrumentation to provide the as-designed fire water supply is verified.

e) Operation of the containment spray remotely operated valve and the continuity of a flow path through the containment spary piping is verified.

Certified Design Material 2.3.4

2.3.4 Fire Protection System

Design Description

A portion of the fire protection system (FPS) provides equipment for manual fire fighting in plant areas that contain equipment required for safe shutdown.

1. The functional arrangement of the applicable portions of the FPS is as shown in Figure 2.3.4-1.

2. The FPS piping identified in Figure 2.3.4-1 remains functional following a safe shutdown earthquake.

3. The applicable portions of the FPS provide the safety-related function of preserving containment integrity by isolation of the FPS line penetrating the containment.

4. The applicable portions of the FPS provide for manual fire fighting capability in plant areas containing equipment required for safe shutdown.

5. Displays of the parameters identified in Table 2.3.4-1 can be retrieved in the main control room (MCR).

6. The applicable portions of the FPS provide nonsafety-related containment spray for severe accident management.

Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.3.4-2 specifies the inspections, tests, analyses, and associated acceptance criteria for the FPS.

Table 2.3.4-1			
Equipment Name	**Tag No.**	**Display**	**Control Function**
Motor-driven Fire Pump	FPS-MP-01A	Yes (Run Status)	Start
Diesel Fire Pump	FPS-MP-01B	Yes (Run Status)	Start
Jockey Pump	FPS-MP-02	Yes (Run Status)	Start

Table 2.3.4-2
Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the applicable portions of the FPS is as shown in Figure 2.3.4-1.	Inspection of the as-built system will be performed.	The as-built FPS conforms with the functional arrangement shown in Figure 2.3.4-1.
2. The FPS piping depicted in Figure 2.3.4-1 remains functional following a safe shutdown earthquake.	i) Inspection will be performed to verify that the piping depicted in Figure 2.3.4-1 is located on the Nuclear Island. ii) A reconciliation analysis using the as-designed and as-built piping information will be performed, or an analysis of the as-built piping will be performed.	i) The piping depicted in Figure 2.3.4-1 is located on the Nuclear Island. ii) The as-built piping stress report exists and concludes that the piping remains functional following a safe shutdown earthquake.
3. The applicable portions of the FPS provide the safety-related function of preserving containment integrity by isolation of the FPS line penetrating the containment.	See Certified Design Material, subsection 2.2.1, Containment System.	See Certified Design Material, subsection 2.2.1, Containment System.
4. The applicable portions of the FPS provide for manual fire fighting capability in plant areas containing equipment required for safe shutdown.	i) Inspection of the passive containment cooling system (PCS) storage tank will be performed. ii) Testing will be performed by measuring the water flow rate as it is simultaneously discharged from the two highest fire-hose stations and when the water for the fire is supplied from the PCS storage tank. Each standpipe will be individually tested.	i) The volume of the PCS tank available to supply the FPS is at least 18,000 gal. ii) Water is simultaneously discharged from each of the two highest fire-hose stations at not less than 75 gpm.

Table 2.3.4-2 (cont.)
Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5. Displays of the parameters identified in Table 2.3.4-1 can be retrieved in the MCR.	Inspection will be performed for retrievability of the parameters in the MCR.	The displays identified in Table 2.3.4-1 can be retrieved in the MCR.
6. The applicable portions of the FPS provide nonsafety-related containment spray for severe accident management.	Inspection of the containment spray headers will be performed.	The FPS has spray headers and nozzles as follows: At least 44 nozzles at plant elevation of at least 235 feet, and 24 nozzles at plant elevation of at least 250 feet.

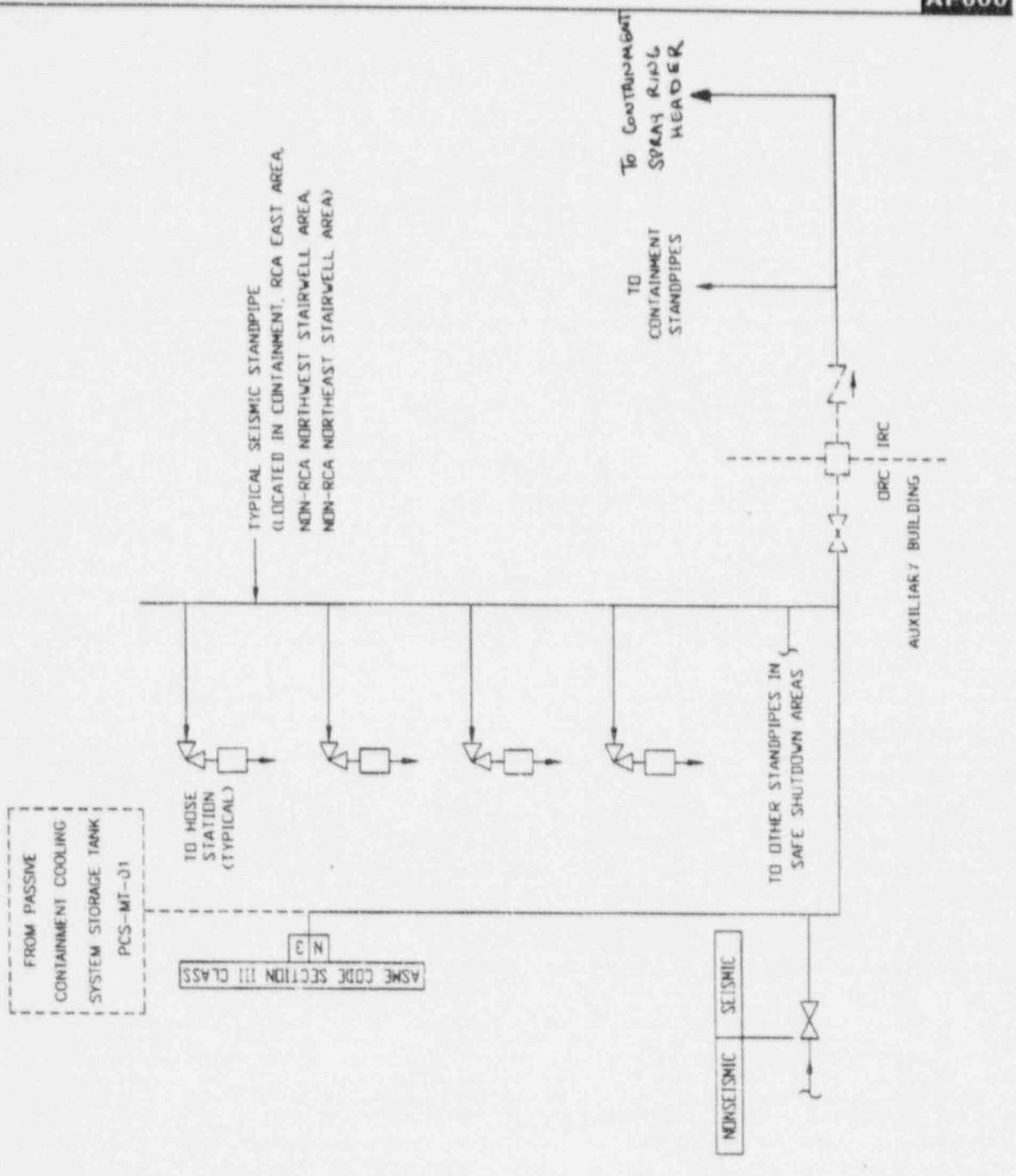

Figure 2.3.4-1
Fire Protection System

NSD-NRC-97-5329
DCP/NRC1039

September 17, 1997

bcc:	S. V. Fanto	WEC 3-09 East	1L, 1A
	M. M. Corletti	WEC 3-06 East	1L, 1A
	R. P. Vijuk	WEC 3-06 East	1L, 1A
	P. A. Chahoy	WEC 4-15 East	1L, 1A
	B. Z. Cowan	Eckert, Seamans, Cherin & Mellott	1L
	R. Lange	DOE	1L
	J. M. Moore	Expo Mart 335	1L
	E. Rodwell	EPRI	1L, 1A
	C. Thompson	DOE	1L
	R. M. Vijuk	WEC 3-7A East	1L
	J. W. Winters	WEC 3-08 East	1L
	AP600 Central File	WEC 3-16 East	1L, 1A
	File 9.0	WEC 3-09 East	1L, 1A

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