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Grouping of Light Water Reactors for Evaluation of Decay Heat Removal Capability

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Prepared for
U.S. Nuclear Regulatory Commission

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ABSTRACT

This grouping report provides a compilation of decay heat removal systems (DHRS) data for operating commercial light water reactors. The reactors have been divided into 12 groups based on similarity of the DHRS and related systems as part of the NRC Task Action Plan on Shutdown Decay Heat Removal Requirements.

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SUMMARY

The decay heat removal systems (DHRS) data have been compiled for the operating commercial light water reactors (LWRs) including those which were anticipated to be operating by 1982. In addition, several plants under construction with associated PRAs were included. These reactors have been divided into groups based on similarity of the DHRS and related systems. In summary, the Westinghouse plants have been divided into four groups; the General Electric plants have been divided into five groups; the Combustion Engineering plants have been divided into two groups; and the Babcock & Wilcox plants have been left as one group. Thus, a total of 12 groups have been identified. With the exception of plants in operation by 1970 (which are the subject of the Systematic Evaluation Program at the NRC), each group is quite cohesive and with minor exceptions, the decay heat removal system-related failures should be similar for each member within a group.

The key grouping characteristics for the BWRs are summarized in Table 1. Groups GE-1 and 2 are the older BWR units and many of them are the subject of the NRCs Systematic Evaluation Program. GE-3 and 4 comprise the bulk of the operating BWRs (17 of 24 units). The major difference between Groups 3 and 4 is the capability to operate the RHR system in the steam condensing mode which is estimated (NUREG/CR-1659 Vol. 4) to improve long-term availability by a factor of 10. GE-5 is comprised of the current generation BWRs.

The key grouping characteristics for the PWRs are summarized in Table 2. Groups W-2, C-E-2 and B&W-1 include the current generation plants from the respective PWR vendors. Group W-4 consists of the oldest units, all of which are being reviewed under the NRCs Systematic Evaluation Program. The units in Groups W-1 and W-3 have high auxiliary feedwater reliability but have distinctly different safety injection systems. The units in W-2 have moderate reliability for their auxiliary feed systems and a third type of safety injection system. Note that the current generation plants can accomplish feed and bleed cooling at operating pressures if both of the charging pumps are operating at rated flow, but if only one train is available, the units must depressurize to allow a safety injection pump to operate. Only Groups W-4 and B&W-1 can accomplish feed and bleed decay heat removal (1.0% power) with one safety injection train at operating pressures. The auxiliary feedwater reliability is emphasized in the PWR grouping scheme since neither the type nor number of auxiliary feedwater pumps correlates well with the previously assessed reliability.

1. INTRODUCTION

The objective of this study is to divide the existing nuclear plants into groups based on the design features of the DHRS for each plant. The groups will be defined such that front line DHR systems performance will be nearly identical within each group. While there are clearly design details (e.g., header and valve placement) that vary greatly from plant to plant, it is the expectation that commonality of function in major components will provide sufficient basis for grouping.

The results of the Reactor Safety Study (WASH-1400) and subsequent probabilistic risk assessments (PRAs) have indicated that failure of the decay heat removal system (DHRS) is a prominent contributor to the risk for the reactors studied. The Generic Issues Branch of the NRC has developed a plan(1) to assess the adequacy of decay heat removal systems in both existing and future light water reactors. While plant specific PRAs provide a direct measure of risk to the public, the perceived urgency of the problem precludes waiting until a PRA is developed for each plant. By separating the individual plants into groups having nearly identical DHR systems, it is expected that any decisions which affect DHR systems that can be justified on the basis of a plant specific PRA will apply to other members of the same DHRS group.

2. GROUPING METHODOLOGY

Many alternative approaches to grouping were considered but the fundamental requirement is that within one group the plants should perform identically (or nearly so) to identical DHRS challenges. Thus, the emphasis has been to group according to similarity of front line DHR systems as listed in Table 3. While the front line systems are similar among the various vendors, the response to DHRS challenges differs radically between vendors and no attempt has been made to incorporate more than one vendor in each group.

The recommended grouping scheme emphasizes the reliability of the auxiliary feedwater systems rather than specific design characteristics but important exceptions to the general classification are identified.

Due to the lack of reliability evaluations for individual safety injection systems, the groupings have used feed and bleed capability and redundancy as key indicators of high pressure injection (HPI) system performance.

2.1 Risk Criteria

Due to inherent uncertainties in consequence analysis and the variations in containment designs and population densities, we do not believe that the existing plants can be assembled into a small number of groups for which the consequence analyses in a given PRA would apply directly to each member of that group. Thus, rather than addressing societal risk directly, this investigation has concentrated on developing groups which can be expected to have similar core melt sequences. The acceptance criterion will then be core melt frequency. For example, Cave[2] has suggested an acceptable frequency of 2.5×10^{-5} for large-scale core melts per reactor year due to DHRS-related failures. Even if core melt frequency alone is later judged to be an inadequate measure for determining "undue risk to the health and safety of the public", the comparison should still be useful. For any given plant, the margin below the acceptable core melt frequency will provide an indication of whether a complete consequence analysis is required to judge acceptability of the risk. For plants that do not meet the criterion, the Task Action Plan[1] will determine whether upgrades to existing systems or dedicated DHR systems should be recommended.

2.2 Scope of the Grouping Study

The grouping study compiled data on the decay heat removal systems (as defined in Table 3) and the related support systems. Note that the Atmospheric Dump Valves (ADVs) on the steam generator have not been considered in the initial grouping study. On some plants the unreliability of the ADVs and their associated motive power may be a significant contributor to the unavailability of the steam generators during shutdown heat removal and Sandia and Oak Ridge are extending the grouping study to include the ADVs. Consideration of ADV reliability and degraded capacity (e.g., failure to open one valve) will be particularly important if credit is to be given to low pressure sources (e.g., fire protection pumps) for steam generator feedwater. Consideration was given only to the basic mechanical configuration of the DHRS, such as number and capacity of pumps, heat exchangers, etc. and whether electrical drawn from redundant Class IE electrical trains. Specific piping arrangment, electrical, instrumentation and controls details were not considered.

The grouping study does not address DHRS failures caused by external events (fires, floods, tornadoes, etc.). Qualitative criteria such as separation and diversity will be developed at Sandia as part of the Task Action Plan [1] to cover such special emergencies.

The diesel generators and associated lube oil, cooling water and electrical equipment were not considered since these systems are being addressed in the NRC's Generic Issue A-44 (Station Blackout). NUREG/CR-3226[4], Station Blackout report has taken a generic approach which indicates that for the typical PWR with two divisions of emergency power and two divisions of shutdown heat removal, blackout initiators become important. However, if we exclude the Systematic Evaluation Plants (pre-1970), give credit for multiple pumps on the same power division and credit for sharing of power and coolant systems between units, then there are only about 10 units which do not exceed the reference plant capability in some significant way. For BWRs with two emergency AC divisions and one or two AC independent condenser systems (representing about half of the existing BWRs), NUREG/CR-3226 indicates that blackout is an important contributor to core melt.

Consideration of containment cooling and related systems is beyond the scope of the present study. The effect of containment-related systems on core melt frequency and consequence analysis will be addressed in the Severe Accident Research and the Accident Sequence Evaluation Programs in the NRC Risk Analysis Division.

The specific plant data and recommended groupings for each reactor vendor are discussed below. The grouping criteria emphasizes similarity of the primary shutdown heat removal systems (auxiliary feedwater systems for the PWRs and isolation cooling for BWRs) but consideration is also given to other systems (high and low pressure coolant injection and RHR systems) as well as thermal hydraulic response (core size, steam generator size, number of loops, etc.). Although the NRC has not yet taken a position on the viability of feed and bleed as a heat removal method, considerable attention is paid to the feed and bleed capability as an indicator of the high pressure ECC system performance capability.

It is a basic belief that while the shutdown heat removal systems may be similar from one vendor to another, the design criteria and thermal/hydraulic response differ so much that any attempt to group more than one vendor together would be misleading. All of these considerations would appear to make grouping an impossible task except that the reactor designs evolved gradually to meet changing design and licensing criteria. This is particularly true of

Westinghouse and General Electric whose early entries into the commercial reactor market are dramatically different from their current designs.

2.3 Performance Criteria

The performance criteria indicated in the FSAR are included with the plant data listing but it should be noted that these criteria are conservatively applied for a broad spectrum of accidents and they tend to be more conservative than the best estimate success criteria as currently used in the PRA's and auxiliary feedwater reliability assessments. In particular, the FSAR for most Westinghouse plants require two motor-driven pumps or one turbine pump for scucessful operation of the auxiliary feedwater system, but the reliability assessment (NUREG-0611) is based on the assumption that one pump is sufficient. Likewise, many of the Westinghouse plants require two out of four injection pumps to preclude core damage for the complete spectrum of small breaks, but the converse (that less than two operational HPI pumps will result in core melt) is clearly not the case. Combustion Engineering sizes their HPI pumps so that one is sufficient to remove decay heat but one pump does not preclude the core from being partially uncovered. General Electric also uses conservative performance criteria and neglects the mitigating effects of RCIC on loss-of-coolant accidents in their safety analysis reports but they have also documented (NEDO-24708) the systems performance capability for other than design transients. While many Westinghouse and Babcock & Wilcox units have three HPI pumps, only two of the three are power by emergency buses. The third pump is often used for maintenance.

3. WESTINGHOUSE PLANT GROUPING

The compilation of systems information for the various Westinghouse plants is given in Table 4. All information is based on the FSARs currently on file at BNL's Nuclear Safety Library and on the LWR safety systems survey performed at Oak Ridge.(3)

All currently operating Westinghouse PWRs were considered, but the following plants have sketchy data due to lack of hard-copy FSARs (or PSARs) at BNL: Haddam Neck Unit 1, North Anna Units 1 and 2, and San Onofre Unit 1.

The following Westinghouse PWRs which are expected to have an operating license by the end of 1982 were also considered: Callaway (SNUPPS) Units 1 and 2, Commanche Peak Units 1 and 2, Diablo Canyon Units 1 and 2, McGuire Units 1 and 2, and Virgil C. Summer Unit 1.

The total number of units considered was thirty-nine (39).

The following systems were considered: high pressure safety injection, CVCS charging (excluding boric acid tanks and pumps), low pressure safety injection, residual heat removal, auxiliary feedwater, component cooling, and essential service water.

In addition to the DHRS, there are also several plant design configurations which have an important impact upon the performance for DHRS failures and the atmospheric release, given that a core melt has occurred. In particular, Westinghouse reactors incorporate:

1. Two basic containment designs (ice condenser or large dry) and several containment cooling systems which affect the release fraction. However, neither the containment type nor the containment cooling systems directly affect DHRS-related core melt frequency, and they have not been considered in the grouping.

2. Three different steam generator designs which affect accident progression for loss-of-feedwater events. The small inventory steam generators (Series 27 and 44) require twice the feedwater flow to prevent dryout as compared to the latter version (Series 51). The exception is Yankee Rowe, which has a very low heat load (150 MW_t) for each of its four Series 27 steam generators.

It should be noted that the Sequoyah and Surry PRAs indicate that DHRS failures are dominant contributors to core melt events for Westinghouse plants if and only if the high and low pressure injection systems are included as part of the DHRS. The suggested grouping is shown in Tables 5 through 8 and the grouping criteria are discussed below.

3.1 Group #1

Group #1 contains all of the three loop plants except San Onofre, Robinson, and Turkey Point.

Criteria:

1. All of the 8 units have been characterized as having high auxiliary feed reliability (NUREG-0611).

2. All HPI systems are designed with sufficient head to lift the pressurizer relief valves with sufficient flow to remove one percent decay heat.

3. All of the plants have two motor driven auxiliary feed pumps and one steam driven auxiliary feed pump.

4. All of the plants have 157 fuel assemblies and primary system inventories which are sized proportionately to the full power level. This leads to similar thermal hydraulic behavior for identical accident sequences.

5. Each of the turbine driven auxiliary feed pumps is sized to deliver 200% of the decay heat load, while the motor driven pumps are sized to deliver 100% of the decay heat load.

Special Considerations:

1. All units have dry containments.

Conclusions:

With minor exceptions, the Surry DHRS seems to be very representative of the systems for the other plants in Westinghouse Group #1. Since Surry meets the suggested core melt criterion (slightly less than 2×10^{-5} DHRS-related core melts per year), the other plants in Group #1 should also be capable of meeting the criterion.

3.2 Group #2

Group #2 consists of the Westinghouse current generation four-loop plants, including eight units scheduled to begin operation by 1983.

Criteria:

1. The plants in Group #2, for which the auxiliary feed systems have been evaluated, were judged (NUREG-0611) to have moderate reliability (a factor of 10 or more lower than the plants in Group #1), except the DC Cook units which have high reliability. Unfortunately, there is no specific design difference which accounts for this poor reliability. Rather, there was an assemblage of faults which led to the assessed lower reliability. This has two important ramifications:

- DHRS failures in other group #2 plants will be at least as important as they are in Surry.
- Auxiliary feedwater reliability evaluations of the new plants (not performed in NUREG-0611) should be conducted. This is presently being done in conjunction with the NRC Safety Evaluation Report for each new plant.

2. None of the operating four-loop plants have sufficient HPI head to lift the relief valves at flow rates capable of removing decay heat. However, the safety grade charging pumps appear to have sufficient capacity to accomplish feed and bleed heat removal at 1% decay heat for all but the Indian Point units which must first depressurize. Depressurization before injection may be preferable for some transients, but the PORVs are typically not safety grade and one or more failures may leave insufficient capacity for depressurization.

3. Most units have 2 motor driven auxiliary feed pumps and one turbine driven auxiliary feed pump, except DC Cook which is still judged (NUREG-0611) to have high auxiliary feed reliability due to sharing of the one motor driven pump per unit, and Trojan which has one diesel driven pump and one turbine driven pump, but a third auxiliary feed pump (motor driven) has been added. Since all of the plants have 3 auxiliary feedwater pumps per unit (except DC Cook), we conclude that they all should have high reliability like group W-1.

4. All of the plants have 193 fuel assemblies and primary inventories which are sized in proportion to the design power level. This leads to similar thermal hydraulic behavior for identical accident sequences.

5. Each of the steam driven auxiliary feed pumps delivers twice the motor driven pump capacity.

6. All of the units have Series 51 steam generators with correspondingly large dryout times (about 35 minutes) except the Indian Point units, which have Series 44 steam generators and shorter dryout times (about 20 minutes).

Special Considerations:

1. Most units have large dry containments except Sequoyah, DC Cook and McGuire, which have ice condensers.

2. The flow from one motor driven pump for the Indian Point units is insufficient to prevent dryout for the loss of main feedwater transient. This in turn would cause overpressurization of the primary system and lifting of the pressurizer relief valves. The possibility of a stuck open relief valve leads a loss of main feedwater to a small break transient.

3. Changes to the auxiliary feed systems to improve the reliability of the Indian Point, Zion, Salem and Trojan units were suggested by the NRC (NUREG-0611), but the net effect on the relative reliability has not been assessed.

4. Full PRAs have been performed for the Zion and Indian Point units by the industry. These industry PRAs should help to establish the relative importance of design variations within the group. Such design variations will be important to consider in assessing DHRS adequacy (Subtask 3.2 of the Task Action Plan(1)) whether or not multiple PRAs are available for a specific group.

Conclusions:

The DHR systems for Westinghouse Group #2 plants appear to be well represented by Sequoyah. With two or more diesels per unit, emergency power availability can also be expected to be similar. The RSSMAP study estimates DHRS-related failures (including small break sequences) to slightly exceed the suggested(2) core melt criterion (2.5×10^{-5} per reactor year). Thus, plants in this group warrant special attention, particularly those judged to have lower AC power or auxiliary feedwater reliability than Sequoyah. Fortunately, the availability of industry PRAs for other units and Indian Point should aid in determining the cohesiveness of the group.

3.3 Group #3

Group #3 consists of the six small two-loop units and three three-loop units. Because there are no reference plants in this group for which a PRA is anticipated to be available, they are compared to Surry.

1. Most of the auxiliary feed systems have been characterized as having high reliability (NUREG-0611) except the Prairie Island units which had a deficiency in technical specifications which has apparently been corrected.

2. None of the HPI systems have sufficient head to lift the relief valves for feed and bleed operation, but the PORVs appear to have sufficient capacity to depressurize to the injection point (bleed and feed).

3. The three dual unit plants have only two auxiliary feed pumps per unit. However, sharing of the auxiliary feedwater between units is judged (NUREG-0611) to still give them high reliability. Ginna, Robinson and Kewaunee have one steam driven and two motor driven auxiliary feed pumps, as does Surry.

4. The steam driven auxiliary feed pumps are sized to prevent dryout for loss of main feedwater transients. Thus, steam driven auxiliary feed pumps for those units with the small steam generators have twice the flow of their respective motor driven pumps.

Special Considerations

1. All of the units have dry containments.

2. Six of the units (Ginna, Robinson, Turkey Point and Point Beach) have the small (Series 44) steam generators and short dryout times (16 to 20 minutes), although the estimates in NUREG-0611 are somewhat inconsistent.

3. The longevity of these plants and the corresponding statistical evidence will allow for a DHRS reliability evaluation with a high degree of confidence in the result. This implies that the Precursor Program in the NRC Research Division will be useful in identifying whether severe accident sequences for this group are well represented by the Surry PRA. Based on operating experience from all commercial reactors the Precursor Report (NUREG/CR-2497) indicates that the overall risk per reactor year may be higher than indicated by the Surry PRA. However, it would appear more useful to apply the precursor results to cohesive groups of plants with extensive operating experience (e.g., Group #1 and #3 of the Westinghouse plants). As a minimum, a division between start-up experience and mature plants (greater than 2 years) should also be considered.

4. The Point Beach and Turkey Point units with only one diesel per unit should be more susceptible to blackout initiators than Surry. At Point Beach and Turkey Point two diesels are shared between two units, and one diesel can supply emergency load in one unit and shutdown loads in the other. In addition, susceptibility to blackout depends on offsite power system reliability as well as diesel generator system reliability and redundancy. The A-44 program is grouping plants into categories related to the susceptibility to station blackout.

5. The lack of diversity in the auxiliary feed trains for Turkey Point (each pump is turbine powered) necessitates special consideration of possible common cause failures. The Turkey Point units are apparently special cases which have less than two auxiliary feed trains per unit but satisfy present reliability requirements. They do not, however, satisfy motive power diversity suggested in the new Branch Technical Position.

Conclusions

The auxiliary feedwater reliability of Westinghouse Group #3 plants is well represented by Surry. However, the short steam generator dryout times for most of the units, the lack of feed and bleed capability in any of the units, and the lack of thermal/hydraulic similarity make Surry a poor reference plant for the group. As previously noted, the availability of operating data can provide a DHRS reliability evaluation which is characterized by a low degree of uncertainty. These reliability studies along with the ongoing systematic evaluation program will help quantify differences between these units and Surry.

3.4 Group #4

Group #4 consists of the three oldest plants, none of which fits logically into any of the previous groups.

Criteria:

1. They all have small steam generators (Series 27).
2. They all were assessed (NUREG-0611) to have low auxiliary feed reliability.
3. They have two auxiliary feed pumps, except Yankee Rowe which has added two motor driven pumps since the NUREG-0611 assessment.
4. They have high head pumps capable of lifting the safety valves for bleed and feed, except Yankee Rowe which cannot. The PORVs in Yankee Rowe appear to have sufficient capacity to depressurize to the injection point (bleed and feed).
5. All of the units have dry containments.

Special Considerations:

1. No reference plant exists which has sufficient similarity for the PRA to apply to these plants.
2. Each of these plants has been reviewed in the systematic evaluation program to examine the extent to which they meet current design criteria.

Conclusions

Although there is no reference plant for Westinghouse Group #4, the low auxiliary feedwater reliability would seem to make it unlikely that the members of this group can meet the DHRS core melt criterion. Again, evaluations of DHRS reliability from operating data may be useful and the ongoing Systematic Evaluation Program of these plants should provide valuable information as to the capability and limitations of the DHR systems.

4. GENERAL ELECTRIC PLANT GROUPING

1. All currently operating General Electric BWRs were considered. Humbolt Bay, which has been shutdown permanently and is scheduled to be dismantled, was not included.

2. The following General Electric plants which are expected to have an operating license by the end of 1982 were also considered: LaSalle Units 1 and 2, Shoreham and Zimmer.

3. Limerick Unit 1 was considered since it has an industry PRA completed. It is the reference plant for BWR Group 4 plants. This plant is expected to be licensed in 1985.

4. The total number of General Electric plants considered was thirty (30).

5. LaCrosse is a small (50 MW) non-GE BWR which is not included in the grouping.

6. The following systems were considered:

   - Isolation condenser or reactor core isolation cooling;

   - RCIC steam condensing mode (generally considered to be an RHR mode)

   - High pressure core spray, high pressure coolant injection, feedwater coolant injection;

   - Automatic depressurization system;

   - Low pressure coolant injection;

   - Low pressure core spray;

   - Reactor shutdown cooling (residual heat removal);

   - Reactor vessel head cooling;

   - Suppression pool cooling;

   - Support systems related to cooling of components (i.e., RHR service water, emergency service water, reactor building cooling water, etc.).

7. The compilation of systems information for the various General Electric plants is shown in Tables 9 through 13. All information is based on the FSARs currently on file at BNL's Nuclear Safety Library and on the LWR safety systems survey performed at Oak Ridge.[3] The abbreviations for the General Electric systems data are given in Table 14 and the recommended groups are summarized in Tables 15 through 19.

4.1 Group #1

Group #1 plants, with the exception of Nine Mile Point 1, are SEP plants.

Criteria:

1. None of these plants have jet pumps.

2. BWR types 1 and 2 comprise all the plants.

3. All of the plants have isolation condensers rather than reactor core isolation cooling.

4. The feedwater coolant injection systems are not safety-related.

5. All plants have a separate shutdown cooling system rather than shutdown cooling being shared with low pressure ECCS.

Conclusions

The Consumers Power Company PRA for Big Rock Point estimated a DHRS-related core melt frequency which was well above Cave's suggested criterion. Although there are important differences in the reactor power level and containment, the similarities in the DHRS systems indicate that the other units will also have diffiulty meeting Cave's criterion. The Systematic Evaluation Program and the Precursor Program should provide additional information with regard to the capabilities and limitations of these units.

4.2 Group #2

Criteria:

1. All the plants are BWR Type 3.

2. All of the plants have isolation condensers rather than reactor core isolation cooling.

3. The plants have either a safety-related high pressure coolant injection or feedwater coolant injection system.

4. All of the plants have low pressure coolant injection systems.

5. All of the plants have a separate shutdown cooling system rather than shutdown cooling being shared with low pressure ECCS.

6. All of the plants have reactor vessel head spray cooling.

Conclusions

The DHR systems of the General Electric Group #2 units are quite similar to the Group #1 systems except that their high pressure make-up (either FWCI or HPCI) is safety related. The Millstone IREP report (NUREG/CR-3085) also indicates that DHRS-related core melt sequences are well above Cave's suggested criterion. The Group #2 units are also part of the Systematic Evaluation Program which should provide additional insight to their capabilities and limitations.

4.3 Group #3

Criteria:

1. The plants are BWR Types 3 or 4.

2. All of the plants have reactor core isolation cooling and high pressure coolant injection.

3. All plants have a residual heat removal system which provides for low pressure coolant injection, shutdown cooling and suppression pool cooling.

4. The steam condensing mode of RHR/RCIC is not a mode of operation at these plants.

Conclusions

The General Electric Group #3 plants are very close to the reference plant (Peach Bottom). Since the Peach Bottom PRA indicates that the plant meets the suggested DHRS-related core melt criterion, the other units should be capable of meeting the criteria as well. NUREG/CR-3226 would indicate that Quad-Cities may be vulnerable to blackouts with less than two diesels per unit. The Browns Ferry IREP report (NUREG/CR-2802) estimates that DHRS-related core melt frequency exceeds Cave's suggested criterion due principally to RHR vulnerability for long-term cooling, but no attempt was made to account for differences with the Reactor Safety Study.

4.4 Group #4

Criteria:

1. The plants are all BWR Type 4.

2. All plants are similar to Group 3 with regard to decay heat removal systems, except the steam condensing mode of RHR/RCIC is available.

Conclusions

The DHR Systems for General Electric Group #4 are similar to Group #3 except that an additional cooling mode (steam condensing) is available for the RHR system. By comparison to the Peach Bottom PRA, the Group #4 units should also be capable of meeting the suggested DHRS-related core melt criterion. The industry PRA for the reference plant (Limerick) also indicates that the DHRS-related core melt frequency will be lower than Cave's criterion.

4.5 Group #5

Criteria:

1. The plants are BWR Types 5 or 6.

2. All plants are similar to Group 4 with regard to decay heat removal systems, except high pressure core spray (motor driven pumps) replaces the high pressure coolant injection (turbine driven pumps), and there is less redundancy in the reactor shutdown cooling mode of the RHR system.

Conclusion

General Electric Group #5 plants incorporate the latest changes the the DHR systems, replacing the HPCI with the HPCS having a dedicated diesel. NUREG/CR-3226 indicates that this gives substantial reduction in blackout related core melts. However, the RSSMAP report for the reference plant (Grand Gulf) indicates that the DHRS-related core melts would be slightly higher than the suggested criterion.

5. COMBUSTION ENGINEERING PLANT GROUPING

1. All currently operating Combustion Engineering PWRs were considered.

2. San Onofre-2, which is expected to have an operating license by the end of 1982, was also considered.

3. The total number of units considered was nine (9).

4. The following systems were considered: high pressure safety injection, CVCS charging (excluding boric acid tanks and pumps), low pressure safety injection, shutdown heat removal, auxiliary feedwater, component cooling, and essential service water.

5. The compilation of DHR systems information for the various Combustion Engineering plants is shown in Tables 20 and 21 and the recommended groupings are summarized in Tables 22 and 23. All information is based on the FSARs currently on file at BNL's Nuclear Safety Library and on the LWR Safety Systems Survey performed at Oak Ridge.[3]

5.1 Group #1

Criteria:

1. All of the units have been characterized as having low to medium auxiliary feeu reliability (NUREG-0635).

2. All of the units have manually initiated auxiliary feedwater systems.

3. None of the HPI pumps can lift the safety valves for feed and bleed cooling except Maine Yankee. However, all the plants in Group #1 have PORVs with sufficient capacity to depressurize and accomplish bleed and feed at about one percent decay heat levels.

Conclusions

The auxiliary feedwater systems for Combustion Engineering Group #1 has substantial variability in the number and type of pumps that are used, but they have been assessed (NUREG-0635) to have similar reliability. The other DHR systems are quite similar to those of the reference plant (Calvert Cliffs). Thus, Calvert Cliffs appears to be representative of the DHR System Performance for C-E Group #1. The Calvert Cliffs RSSMAP report indicates that the DHRS-related core melt frequency is an order of magnitude higher than the suggested criterion.

5.2 Group #2

Criteria:

1. The units have been characterized as having medium auxiliary feed reliability (NUREG-0635), except San Onofre 2 which is assessed to have high reliability (NUREG/CR-2153).

2. The units have automatically initiated auxiliary feedwater systems.

3. The HPI pumps do not have the capability to lift the safety valves.

4. Fort Calhoun and ANO-2 have PORVs with sufficient capacity to depressurize to accomplish bleed and feed decay heat removal.

Conclusions

Until a representative PRA becomes available for Combustion Engineering Group #2 plants, it will be difficult to make any conclusions with regard to the adequancy of their DHR systems.

6. BABCOCK & WILCOX PLANT GROUPING

1. All currently operating B&W PWRs were considered (TMI-2 was not included). A total of eight (8) units were considered.

2. The following systems were considered: high pressure safety injection (makeup and purification), low pressure safety injection, decay heat removal, emergency feedwater, component cooling systems, and service water systems.

3. The compilation of systems information for the various Babcock & Wilcox plants is shown in Table 24. All information is based on the FSARs currently on file at BNL's Nuclear Safety Library and on the LWR Safety Systems Survey performed at Oak Ridge.(3)

There appears to be no major differences in the B&W DHRS, and they have been assembled as one group. However, there are minor design differences that may be important for specific accident sequences. These design differences are highlighted in Table 25 and the grouping criteria are discussed below.

6.1 Group #1

1. All units have three high pressure safety injection pumps capable of lifting the power operated relief valves, at a flow sufficient for feed and bleed, except Davis Besse which is the only unit with separate makeup pumps capable of lifting the PORVs. However, the makeup pump flow rate at the PORV set point is insufficient to remove full decay heat. Each of the units has one PORV with sufficient capacity to depressurize, but even at 1600 psi Davis Besse would not be able to inject at sufficient flow rates to remove decay heat.

2. All units have two low pressure safety injection pumps, except the Oconee units which have three each.

3. All of the DHR systems have two coolers and utilize the low pressure safety injection pumps.

4. All of the emergency feedwater systems have one turbine driven pump and two half-sized or one full-sized motor driven pump, except Davis Besse which has two turbine auxiliary feed pumps.

5. All of the units have a once-through steam generator with sufficient inventory to prevent dryout for 25 to 30 seconds. However, for the once-through design the thermal center changes rapidly during dryout and only Davis Besse has sufficient elevation (in the "raised loop" design) to promote natural circulation for low steam generator levels. For the other units the emergency feedwater inlet is elevated to promote natural circulation.

6. All of the units have a small pressurizer (13% of the primary volume) which contributes to the frequency of overpressure transients which lift the relief valves. However, recent additions to the trip signals and relief setpoints may have eliminated this problem.

Conclusions

Although several Babcock & Wilcox plants (Crystal River, Oconee and Three Mile Island) have two motor-driven Emergency Feedwater Systems (EFS) pumps instead of one, the existing EFS reliability evaluation (BAW-1584) does not take credit for the additional pump. Thus, all of the Babcock & Wilcox plants are judged to have similar ESF reliability. With this qualification, the DHR systems for the Babcock & Wilcox plants are quite similar and they have been included as one group. The reference plant IREP report (NUREG/CR-2787) indicates that nearly all of the dominant core melt sequences involve DHR failures and the estimated frequency is above the DHR-related core melt criterion. This result is fairly consistent with the Oconee RSSMAP study, but the Crystal River IREP report indicates that core melt is much more likely for that plant.

7. NEW PLANTS

We have conducted a brief review of the nuclear plants presently undergoing an operating license review so that they may also be compared to any DHRS criteria that are developed. The review of new plants has been limited to the key DHRS characteristics outlined in Tables 1 and 2. On this basis, most of these new units appear to fit into the grouping developed previously. Specifically:

- The new Westinghouse plants (Byron 1 and 2, Braidwood 1 and 2, Catawba 1 and 2, Seabrook 1 and 2, South Texas 1 and 2, Watts Bar 1 and 2, and Wolf Creek) are all current generation plants that are similar to the Westinghouse standard plant (SNUPPS) and appear to belong to Group W-2. There is some variation in the auxiliary feedwater systems in that three of the plants (Byron, Braidwood and Seabrook) have only one motor-driven pump and one turbine-driven pump per unit, but the reliability of all of the auxiliary feedwater systems will be assessed against the NRC's Standard Review Plan criterion. All of the units have feed and bleed capability at operating pressures using 2 charging pumps to remove 1% decay heat. They also have the capability to open PORVs to depressurize to the safety injection point if only one ECC train is available. The South Texas ECC system is somewhat different than the others in that it has 3 safety injection pumps instead of two and does not include the charging pumps in the ECC system. The South Texas units also have higher power levels than any of the other units in Group W-2 and appear to be a logical candidate for a detailed review of DHR systems.

- Three of the new General Electric plants (Hope Creek, Fermi 2, and Susquehanna 1 and 2) are BWR 4 Plants with the same key DHRS characteristics as those in Group GE-4 including the steam condensing mode of RHR heat removal. The other new General Electric plants (Clinton 1 and 2, River Bend 1 and 2, Washington 2 and Zimmer) are current generation plants with similar DHR systems to the GE-5 group including the AC powered HPCS system and the 3 loop LPCI system.

- Two of the three new Babcock and Wilcox plants (Bellefonte 1 and 2 and WPPS-1) have much larger power ratings than the operating B&W plants and appear to represent a new generation of plants not previously considered in the grouping scheme. However, based only on the key DHRS characteristics, all three plants (including Midland 1 and 2) fit readily into Group B&W-1. They all have 3 safety injection pumps any one of which is capable of lifting the PORVs at sufficient flow rates to remove 1% decay heat (i.e., feed and bleed). Also, they all have three auxiliary feedwater pumps per unit (Midland has committed to adding a second motor-driven pump). In this respect they will probably have better auxiliary feedwater reliability than the reference plant (ANO-1) which has only two auxiliary feedwater pumps.

- All of the new Combustion Engineering plants (Palo Verde 1,2 and 3, St. Lucie 2, San Onofre 3 and Waterford) have similar DHR systems to Group C-E-2. All of the units have 1 turbine-driven and 2 motor-driven auxiliary feed pumps. None of the HPI pumps can lift the safety valves nor do any of the units have PORVs for depressurization to the injection point. Four of the units (St. Lucie 2 and Palo Verde 1, 2 and 3) have 2 high pressure injection pumps instead of 3. This reduction in HPI redundancy is consistent with the current generation System 80 design but only the Palo Verde units have the higher power rating (3817 MW_t) specified for System 80 plants.

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2. L. Cave and W. E. Kastenberg, "A Quantitative Probabilistic Goal for Decay Heat Removal System Reliability," NUREG/CR-3778, SAND84-7126, to be published.

3. F. A. Heddleson, "Summary of Light-Water-Reactor Safety Systems," NUREG/CR-2069, October 1981.

4. A. M. Kolaczkowski and A. C. Payne, "Station Blackout Accident Analyses (Part of NRC Task Action Plan A-44)," NUREG/CR-3226, May 1983.

TABLE 1

SUMMARY OF KEY DHRS GROUPING CHARACTERISTICS FOR BWRs

Group	Isolation Cooling	High Pressure Make-up	Low Pressure Make-up Systems LPCI	LPCS	RHR System
GE-1	Natural Circulation Isolation Condenser.	FWCI except Dresden has HPCI (none are safety). Big Rock Point has no high pressure makeup system. All require AC or steam power.	None	2 to 4 AC Power Redundant Loops.	Shutdown Cooling non-safety.
GE-2	Natural Circulation Isolation Condenser.	HPCI except Millstone has FWCI (all are safety). All require AC or Steam Power.	4 AC Powered Pumps (33% each).	2 AC Powered Redundant Loops.	Shutdown Cooling Safety System.
GE-3	Turbine-Driven Pump (RCIC).	HPCI with Turbine Driven Pump	4 AC Powered Pumps (50% each). 2 Loops	2 AC Powered Redundant Loops.	4 AC Pumps. 2 Redundant Loops. No Steam Condensing Mode.
GE-4	Turbine-Driven Pump (RCIC).	HPCI with Turbine Driven Pump	4 AC Powered Pumps (50% each). 2 Loops except Limerick which has 4 separate injection lines.	2 AC Powered Redundant Loops.	4 AC Pumps. 2 Redundant Loops. Steam Condensing Mode Available.
GE-5	Turbine-Driven Pump (RCIC).	HPCS with AC Pump	3 AC Powered Pumps (100% each). 3 Loops	1 AC Powered Loop.	3 AC Pumps. 3 Redundant Loops. Steam Condensing Mode Available.

TABLE 2

SUMMARY OF KEY DHRS GROUPING CHARACTERISTICS FOR PWRs

Group	Aux. Feed Reliability(1)	Feed & Bleed Capability(2)	Bleed & Feed Capability (3)	Number of High Head Injection Pumps	Number of Low Head Injection Pumps	RHR Independence	High Pressure Recirculation Requirements	Number of Steam Generators
W-1	High	Yes (2/3 HPSI Pumps)	Yes (1/3 HPSI Pumps)	3 Turkey Pt. has 2	2 Surry has 4	Dual Function LPSI (except Surry)	1/3 HPSI Pumps 1/2 LPSI Pumps	3
W-2	Moderate except Cook is high	Yes (2/2 Charging Pumps) except Indian Point	Yes (1/2 SI Pumps)	4 (Includes 2 Charging) except Indian Point has 3 Safety Injection Pumps	2 Indian Point has 4	Dual Function LPSI (except Indian Pt.)	1/2 Charging Pumps 1/2 LPSI Pumps	4
W-3	High except Prairie Is.	No	Yes (1/2 SI Pumps)	2 except Ginna and Robinson have 3	2	Dual Function LPSI	1/2 HPSI Pumps (assumes depressurized) 1/2 LPSI	2 Robinson & Turkey Pt. have 3 each
W-4	Low	Yes (1/2 Charging Pumps) except Yankee Rowe	Yes	2 except Yankee Rowe has 3	2	Independent	Unknown	4 San Onofre has 3
C-E-1	Low	No except Maine Yankee	Yes (1/3 SI Pumps)	3	2	Dual Function LPSI	1/3 SI Pumps	2 Maine Y. has 3
C-E-2	Moderate San Onofre is High	No	Yes except San Onofre	3	2	Dual Function LPSI	1/3 SI Pumps	2
B&W-1	Moderate but on a different scale	Yes except Davis Besse	Yes except Davis Besse	3 Davis Besse has 4	2 Davis Besse has 3	Dual Function LPSI	1/3 SI Pumps 1/2 LPSI Pumps	2

(1) Based on NUREG-0611, NUREG-0635, and BAW-1584 assessments.

(2) Feed and bleed as used within this report means sufficient flow from the high pressure pumps at the PORV setpoint to remove 1% of full power.

(3) Bleed and feed as used within this report means sufficient flow from the high pressure pumps to remove 1% of full power after depressurizing the primary system by opening the PORV's.

TABLE 3

PRINCIPAL DECAY HEAT REMOVAL SYSTEMS CONSIDERED IN THE GROUPING STUDY

PWR Front Line Systems
Auxiliary Feedwater System.
High Pressure Injection System.
Low Pressure Injection System.
High Pressure Recirculation System.
Low Pressure Recirculation System.
Chemical and Volume Control System.
Residual Heat Removal System.

BWR Front Line Systems
Isolation Condenser or Reactor Core Isolation Cooling.
High Pressure Core Spray, High Pressure Coolant Injection, Feedwater Coolant Injection.
Automatic Depressurization System.
Low Pressure Coolant Injection.
Low Pressure Core Spray.
Reactor Shutdown Cooling (Residual Heat Removal).
Steam Condensing Mode of RHR/RCIC.
Reactor Vessel Head Cooling.
Suppression Pool Cooling.

Support Systems
Power Systems.
Lubrication and Cooling.
Control and Instrumentation.
Coolant Supply Systems (Suction Sources).

TABLE 4

WESTINGHOUSE DECAY HEAT REMOVAL SYSTEMS

NOTE: ALL DATA IS PER UNIT UNLESS OTHERWISE NOTED.

PLANT NAME	UNIT NO.	CONT. TYPE	CORE POWER MWT / NO. OF LOOPS	HIGH PRESSURE SAFETY INJECTION SYSTEM (1) NO. OF PUMPS	TYPE	SUCTION SOURCES	CVCS CHARGING SYSTEM (2) NO. OF PUMPS	TYPE	SAFETY GRADE
1. SEQUOYAH REFERENCE PLANT 4 LOOPS	1 & 2	ICE COND.	3411/4	2	CENT.	RWST, LPSIS	2 1	CENT. PD-VS	YES NO
2. CALLAWAY (SNUPPS)	1 & 2	DRY	3425/4	2 (RESAR-3)	CENT.	RWST, LPSIS	2 (NOT THE SAME AS HPSI AS PER RESAR-3) 1	CENT. PD-VS	YES NO
3. COMMANCHE PEAK	1 & 2	DRY	3425/4	2	CENT.	RWST, LPSIS	2 1	CENT. PD-VS	YES NO
4. DCCOOK	1 & 2	ICE COND.	3250/4	2	CENT.	RWST, LPSIS	2 1	CENT. PD-VS	YES NO
5. DIABLO CANYON	1 & 2	DRY	3338/4	2	CENT.	RWST, LPSIS	2 1	CENT. PD-VS	YES NO
6. HADDAM NECK	1	DRY	1825/4	2			2		
7. INDIAN POINT	2	DRY	2758/4	3 1/3 REQ'D	CENT.	RWST, LPSIS	3	PD-VS	NO
8. INDIAN POINT	3	DRY	3025/4	3 1/3 REQ'D	CENT.	RWST LPSIS	3	PD-VS	NO
9. McGUIRE	1 & 2	ICE COND.	3425/4	2 ALSO UHI	CENT.	RWST, LPSIS	2 1	CENT. PD-VS	YES NO
10. SALEM	1 & 2	DRY	3338/4	2	CENT.	RWST, LPSIS	2 1	CENT. PD-VS	YES NO

PLANT NAME	LOW PRESSURE SAFETY INJECTION SYSTEMS NO. OF PUMPS	TYPE	SUCTION SOURCES	RESIDUAL HEAT REMOVAL SYSTEM NO. OF PUMPS	TYPE	SUCTION SOURCES
1. SEQUOYAH	2	CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI		
2. CALLAWAY	2 (AS PER RESAR-3)	CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI (AS PER RESAR-3)		
3. COMMANCHE PEAK	2	CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI		
4. DCCOOK	2	CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI		
5. DIABLO CANYON	2	CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI		
6. HADDAM NECK	*			*		
7. INDIAN POINT	2 RECIRCULATION PUMPS	CENT.	RECIRC. SUMP	2 2 HX INSIDE CONT. PUMPS ARE BACK-UP TO RECIRCULATION PUMPS	CENT.	CONT. SUMP
8. INDIAN POINT	2 RECIRCULATION PUMPS	CENT.	RECIRC. SUMP	2 BACK-UP TO RECIRCULATION	CENT.	RWST SUMP
9. McGUIRE	2	CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI		
10. SALEM	2	CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI		

PLANT NAME	AUXILIARY FEEDWATER SYSTEM NO. OF PUMPS	TYPE	CAPACITY GPM	CAPACITY FT/PSIG
1. SEQUOYAH	2 1	MOTOR STEAM	440 EACH 50% 880	7900 FT. 2/4 SGS 2600 FT. ALL 4 SGS
2. CALLAWAY	2 1	MOTOR STEAM	600 EACH 1200 (AS PER SNUPPS PSAR)	1700 PSIG 3200 FT.
3. COMMANCHE PEAK	2 1	MOTOR STEAM	470 EACH 50% 900	1107 PSIA
4. DCCOOK	1 1	MOTOR STEAM	450 50% 900	2714 FT.
	MOTOR PUMPS SUPPLY BOTH UNITS			
5. DIABLO CANYON	2 1	MOTOR STEAM	440 EACH 800	3000 FT.
	STEAM PUMP PREFERRED FOR SHUTDOWN			
6. HADDAM NECK	2	STEAM	450 EACH	1000 PSIA
7. INDIAN POINT	2 1	MOTOR STEAM	400 EACH 50% 800	1350 PSIG
8. INDIAN POINT	2 1	MOTOR STEAM	400 EACH 50% 800	1350 PSIG
9. McGUIRE	2 1	MOTOR STEAM	450 EACH 50% 900	1672 PSIG 1788 PSIG
10. SALEM	2 1	MOTOR STEAM	440 EACH 50% 800	1300 PSI 1550 PSI

PLANT NAME	COMPONENT COOLING WATER SYSTEM NO. OF PUMPS/HXS	PUMP TYPE	CAPACITY (EACH)	SERVICE WATER SYSTEM NO. OF PUMPS	TYPE	CAPACITY (EACH)	PRIMARY ESF SUCTION SOURCE
1. SEQUOYAH	5/3 BET. BOTH UNITS	CENT.	9000 GPM	8/BOTH UNITS 1 AUX. PUMP/UNIT	VERT. CENT.	9000 GPM 180 FT. 12,600 GPM 155 FT.	SEISMIC I MECH. DRAFT AUX. COOLING TOWERS 3/4 CELLS REQ'D
2. CALLAWAY	4/2 (AS PER SNUPPS PSAR)	HOR. CENT.	100% EACH	2 (AS PER CALLAWAY FSAR)	VERT. CENT.	1500 328 FT. 100% EACH &	SEISMIC I COOLING TOWERS 4 CELLS RETENTION POND
3. COMMANCHE PEAK	2/2	HOR. CENT.	14,700 GPM 226 FT. 100 % EACH	2	VERT. CENT.	17,000 GPM 180 FT. 100 % EACH	SEISMIC I SAFE SHUTDOWN IMPOUNDMENT
4. DCCOOK	5 PUMPS BET. BOTH UNITS 2HX/UNIT	HOR. CENT.	9900 GPM	2	VERT. CENT.	10,000 GPM 145 FT.	SEISMIC I LAKE INTAKE STRUCTURE
5. DIABLO CANYON	3/2	HOR. CENT.	9200 GPM 145 FT.	2	VERT. CENT.	11,000 GPM 115 FT. 100% EACH	SEISMIC I PACIFIC OCEAN INTAKE STRUCTURE
6. HADDAM NECK	*			*			
7. INDIAN POINT	3/2	HOR. CENT.	3600 GPM 220 FT.	6	CENT.	5000 GPM 220 FT.	SEISMIC I - HUDSON RIVER INTAKE STRUCTURE
8. INDIAN POINT	3/2	HOR. CENT.	3600 GPM 220 FT.	6	CENT.	5000 GPM 220 FT.	RIVER SEISMIC INTAKE
9. McGUIRE	4/2	CENT.	4300 GPM 130 FT. 50% EACH	2	HOR. CENT.	17,500 GPM 130 FT. 100% EACH	STANDBY SEISMIC I SWS POND
10. SALEM	3/2 NORMAL 1-2 PUMPS/1HX REQ'D POST LOCA 1 PUMP/1HX REQ'D	HOR. CENT.	4600 GPM 200 FT.	6 NORMAL 4/6 REQ'D POST LOCA RECIRC. 3/6 REQ'D	VERT. TURBINE	10,875 GPM 240 FT.	SEISMIC I INTAKE STRUCTURE

NOTE: PD-VS POSITIVE DISPLACEMENT - VARIABLE SPEED.
*Information not presently available.

(1) In plants with 3 HPI pumps, delivery from one out of three is required for successful mitigation of small breaks but only two are powered by emergency buses and the third pump is generally offline.

(2) In plants with two safety grade charging pumps, the charging pumps perform the high pressure injection function while the Safety Injection pumps have a shutoff head below operating pressures. Thus, there are four high head safety injection pumps and one of each type (2/4) is required by the FSAR to mitigate the full spectrum of small breaks.

TABLE 4 (CONT.)

PLANT NAME	UNIT NO.	CONT. TYPE	CORE POWER MWT / NO. OF LOOPS	HIGH PRESSURE SAFETY INJECTION SYSTEM (1) NO. OF PUMPS	HPSI TYPE	HPSI SUCTION SOURCES	CVCS CHARGING SYSTEM (2) NO. OF PUMPS	CVCS TYPE	CVCS SAFETY GRADE	LOW PRESSURE SAFETY INJECTION SYSTEMS NO. OF PUMPS	LPSI TYPE	LPSI SUCTION SOURCES	RESIDUAL HEAT REMOVAL SYSTEM NO. OF PUMPS	RHR TYPE	RHR SUCTION SOURCES
11. TROJAN	1	DRY	3411/4	2	CENT.	RWST, LPSIS	2 1	CENT. (DUAL FUNCTION-HPSI) PD-VS	YES NO	2	VERT. CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI		
12. YANKEE ROWE	1	DRY	600/4	3 200 GPM 1850 FT. S/O HD		SIT	3	PD (2 HAVE VS MOTORS)	NO	3	200 GPM		1P/1HX L.P. SURGE TANK		RCS
13. ZION	1 & 2	DRY	3250/4	2	CENT.	RWST, LPSIS	2 1	CENT. (DUAL FUNCTION-HPSI) PD-VS	YES NO	2 1	CENT. MOTOR CENT. DIESEL-DRIVEN FUTURE	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI		
										2-LOOP PLANTS - USE 3-LOOP SURRY PLANT AS REFERENCE					
14. GINNA	1	DRY	1520/2	3 1/3 REQ'D	CENT.	RWST, LPSIS	3	PD-VS	NO	2	HOR. CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI 2 HX		
15. KEWAUNEE	1	DRY	1650/2	2	CENT.	RWST, LPSIS	3	PD-VS	NO	2	CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI SEPARATE RHR SUMP		
16. POINT BEACH	1 & 2	DRY	1518/2	2	CENT.	RWST, LPSIS	3	PD-VS	NO	2	CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI		
17. PRAIRIE ISLAND	1 & 2	DRY	1650/2	2	CENT.	RWST, LPSIS	3	PD-VS	NO	2	CENT.	RCS, RWST, SUMP	DUAL FUNCTION-LPSI		

PLANT NAME	AUXILIARY FEEDWATER SYSTEM NO. OF PUMPS	AFW TYPE	AFW CAPACITY GPM	AFW CAPACITY FT/PSIG	COMPONENT COOLING WATER SYSTEM NO. OF PUMPS/HXS	CCW PUMP TYPE	CCW CAPACITY (EACH)	SERVICE WATER SYSTEM NO. OF PUMPS	SW TYPE	SW CAPACITY (EACH)	PRIMARY ESF SUCTION SOURCE
11. TROJAN	1 1	STEAM DIESEL	960 960	100% 3400 FT.	3/2	HOR. CENT.	10,500 GPM 140. FT. 100% EACH	3 1/3-NORMAL OP. 1/3-POST LOCA	VERT. CENT.	20,000 GPM 85 FT.	SEISMIC I RIVER INTAKE STRUCTURE, COOLING TOWERS, FORCED OR NATURAL
12. YANKEE ROWE	1 CHARGING & SIS SERVE AS BACK-UP 2	STEAM MOTOR	90 100%	1200 PSI	2/2	CENT.	2000 GPM	3 2/3 NORMAL OP.	VERT. CENT.	2500 GPM	CIRC. WATER PUMP HOUSE
13. ZION	2 1	MOTOR STEAM	450 EACH 900	3099 FT.	5/3 BET. BOTH UNITS 1P/1HX PER UNIT-NORMAL OP. 2P/1HX PER UNIT-COOLDOWN (1P/1HX SHARED BET. UNITS)	HOR. CENT.	4600 GPM 200 FT.	6 BET. BOTH UNITS 2P/UNIT-NORMAL OP. 1P/UNIT-EMERG. SHUTDOWN	CENT.	22,000 GPM 210 FT.	SEISMIC I LAKE INTAKE STRUCTURE
14. GINNA	2 1 2 (STANDBY MANUAL START PUMPS)	MOTOR STEAM MOTOR	200 EACH 400 200 EACH	1114 PSIG 1131 PSIG 50%	2/2 1P/1HX	HOR. CENT. NORMAL OP. OR POST LOCA	2980 GPM 180 FT. 100% EACH	3 1/3 NORMAL OP. 2/3 POST LOCA		5300 GPM 198 FT.	SEISMIC I LAKE INTAKE STRUCTURE
15. KEWAUNEE	2 1	MOTOR STEAM	240 EACH 240	100% 2850 FT.	2/2 1P/1HX	HOR. CENT. NORMAL OP. OR POST LOCA	3650 GPM 220 FT.	4	CENT.	6400 GPM 50% EACH	SEISMIC I LAKE MICHIGAN INTAKE STRUCTURE
16. POINT BEACH	1 1 (MOTOR PUMPS CAN FEED EITHER UNIT)	MOTOR STEAM	200 400	50% 1192 PSIG	2/1 3rdHX SHARED BET. UNITS PUMPS INTERCONNECTED	HOR. CENT.	3650 GPM 220 FT.	6 BET. BOTH UNITS 2/6 NORMAL OP. - PER UNIT	CENT.	6800 GPM	SEISMIC LAKE MICHIGAN INTAKE STRUCTURE
17. PRAIRIE ISLAND	1/UNIT 1/UNIT (MOTOR PUMP NORMALLY FEEDS OPPOSITE UNIT)	MOTOR STEAM	220 220	100% 1200 PSIG	2/4 PUMPS INTERCONNECTED BET. UNITS	CENT.	4000 GPM EACH	2 2 1	MOTOR DIESEL MOTOR	17,500 GPM 17,500 GPM STANDBY	SEISMIC I INTAKE CANAL

*Information not presently available.

TABLE 4 (CONT.)

PLANT NAME	UNIT NO.	CONT. TYPE	CORE POWER MWT / NO. OF LOOPS	HIGH PRESSURE SAFETY INJECTION SYSTEM(1) NO. OF PUMPS	TYPE	SUCTION SOURCES	CVCS CHARGING SYSTEM (2) NO. OF PUMPS	TYPE	SAFETY GRADE
18. SURRY REFERENCE PLANT 3 LOOPS	1 & 2	DRY SUB-ATM.	2441 / 3	3	HOR./ CENT.	RWST, LPSIS, VCT	DUAL FUNCTION HPSI		
19. BEAVER VALLEY	1	DRY	2660 / 3	3	CENT.	RWST, LPSIS	2 (DUAL FUNCTION-HPSI) 1	CENT. PD	YES NO
20. FARLEY	1 & 2	DRY	2652 / 3	3	CENT.	RWST, L*SIS	DUAL FUNCTION HPSI		
21. H. B. ROBINSON	2	DRY	2200 / 3	3	CENT.	RWST, LPSIS	INCOMPLETE B&L FSAR ASSUME DUAL FUNCTION-HPSI		
22. NORTH ANNA	1 & 2	DRY SUB-ATM.	2775 / 3	3	CENT.		DUAL FUNCTION HPSI		
23. SAN ONOFRE	1	DRY	1347 / 3	*			2 2400 PSI S/O	CENT.	YES NO
24. TURKEY POINT	3 & 4	DRY	2208 / 3	2	CENT.	RWST, (CROSS-TIED) LPSIS	3	PD-VS	NO
25. VIRGIL C. SUMMER	1	DRY	2785 / 3	3	CENT.	RWST, LPSIS, VCT	DUAL FUNCTION HPSI		

PLANT NAME	LOW PRESSURE SAFETY INJECTION SYSTEMS NO. OF PUMPS	TYPE	SUCTION SOURCES	RESIDUAL HEAT REMOVAL SYSTEM NO. OF PUMPS	TYPE	SUCTION SOURCES	AUXILIARY FEEDWATER SYSTEM NO. OF PUMPS	TYPE	CAPACITY GPM	CAPACITY FT/PSIG
18. SURRY	2 ALL HEAT REMOVAL BY RECIRC. SPRAY SUBSYSTEM NO HXS IN SIS	VERT. CENT.	RCS, RWST, CONT. SUMP	2 ENTIRE SYSTEM INSIDE CONT. - NOT ESFS	CENT.		2 1 1 PUMP CAN FEED OPPOSITE UNIT	MOTOR STEAM	350 EACH	50% 2730 FT.
19. BEAVER VALLEY	2	CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI			2 1	MOTOR STEAM	350 EACH 700	50% 2696 FT.
20. FARLEY	2	CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI			2 1	MOTOR STEAM	350 EACH 700	50% 126R PSIG
21. H. B. ROBINSON	2	CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI			2 1	MOTOR STEAM	300 EACH 600	50% 1300 PSI
22. NORTH ANNA	*			*			2 1	MOTOR STEAM	350 EACH 700	50% 2800 FT.
23. SAN ONOFRE	*			2P/2HX			1 1	MOTOR STEAM	235 100% 300	1065 PSI 1110 PSI
24. TURKEY POINT	2	VERT. CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI			3 ONE PUMP NORMALLY SUPPLIES EACH UNIT - THIRD PUMP IS BACK-UP FOR EITHER UNIT	STEAM	600 EACH	2775 FT.
25. VIRGIL C. SUMMER	2	CENT.	RCS, RWST, CONT. SUMP	DUAL FUNCTION-LPSI			2 1	MOTOR STEAM	400 EACH 1010	50% 1211 PSIG

PLANT NAME	COMPONENT COOLING WATER SYSTEM NO. OF PUMPS/HXS	PUMP TYPE	CAPACITY (EACH)	SERVICE WATER SYSTEM NO. OF PUMPS	TYPE	CAPACITY (EACH)	PRIMARY ESF SUCTION SOURCE
18. SURRY	2/2 1/1 NORMAL OP. PER UNIT	HOR. CENT.	9000 GPM 200. FT.	3 DIESEL-DRIVEN FOR BOTH UNITS 1/3 DUAL DRIVE (DIESEL-ELECTRIC) ALL 3 ARE BACK-UP TO CIRC. WATER PUMPS	CENT.	15,000 GPM 45 FT.	SEISMIC I RIVER INTAKE STRUCTURE
19. BEAVER VALLEY	3/3	HOR. CENT.	4700 GPM	3	VERT. CENT.	9000 GPM	SEISMIC I RIVER INTAKE STRUCTURE
20. FARLEY	3/3	HOR. CENT.	6700 GPM 175 FT.	5 FOR UNIT 1		9000 GPM	SEISMIC I RIVER INTAKE STRUCTURE, STORAGE POND
21. H. B. ROBINSON	3/2 2/3 NORMAL OP. 1/3 POST LOCA	INCOMPLETE	B&L FSAR	4 3/4 - NORMAL OP. 2/4 - POST LOCA	CENT.	3200 GPM 100 FT.	SEISMIC I LAKE INTAKE STRUCTURE
22. NORTH ANNA	*			*			
23. SAN ONOFRE	3/2		2218 GPM	2 1/2 NORMAL 2/2 RHR MODE			
24. TURKEY POINT	3/3 1P/2HX POST LOCA	HOR. CENT.	7500 GPM 185 FT.	3 2/3 NORMAL OP. 1/3 POST LOCA	CENT.	18,000 GPM 60 FT.	SEISMIC I SEAWATER INTAKE STRUCTURE
25. VIRGIL C. SUMMER	3/2 2 SPEED PUMPS	HOR. CENT.	11,700 GPM 165 FT. 100% EACH	3	VERT. CENT.	18,600 GPM 87 FT. 100% EACH 2 SPEED PUMPS	SEISMIC I SWS POND

TABLE 5

PRELIMINARY DHRS GROUPING
WESTINGHOUSE GROUP #1 SIMILAR TO SURRY (RSS)

PLANT	POWER (MW)	LOOPS	CONTAINMENT	DHRS DIFFERENCES	COMMENTS
SURRY 1,2	2441	3	DRY, SUB ATOMS.	REFERENCE PLANT	PRA (WASH-1400)
BEAVER VALLEY	2652	3	DRY	2 HPI PUMPS AUX FEED FROM RWST, FPS, RIVER NO AUX FEED FROM SISTER PLANT	
FARLEY, 1,2	2660	3	DRY	3 AUX FEED TRAINS AUX FEED FROM CST AND SERV. WATER NO AUX FEED FROM SISTER PLANT SAFETY GRADE RHR	
NORTH ANNA 1,2	2775	3	DRY, SUB ATMOS.	AUX FEED FROM CST, SERV. WATER AND FPS	
V.C. SUMMER	2785	3	DRY	NO AUX FEED FROM SISTER PLANT	

TABLE 6

PRELIMINARY DHRS GROUPING
WESTINGHOUSE GROUP #2 SIMILAR TO SEQUOYAH (RSSMAP)

PLANT	POWER (MW)	LOOPS	CONTAINMENT	DHRS DIFFERENCES	COMMENTS
SEQUOYAH 1,2	3411	4	ICE CONDENSER	REFERENCE PLANT	PRA (RSSMAP; INDUSTRY)
DIABLO CANYON 1,2	3338	4	DRY	3 HPI PUMPS	EARTHQUAKE INITIATORS
INDIAN POINT-2	2758	4	DRY	NON SAFETY RHR AUX FEED FROM CST, CITY 3 HPI PUMPS	PRA (INDUSTRY)
INDIAN POINT-3	3025	4	DRY	NON SAFETY RHR AUX FEED FROM CST, CITY 3 HPI PUMPS	PRA (INDUSTRY)
ZION 1,2	3250	4	DRY	AUX FEED FROM CST, SERV. WATER	PRA (INDUSTRY)
DC COOK 1,2	3250	4	ICE CONDENSER	AUX FEED FROM CST, SERV. WATER AUX FEED FROM SISTER PLANT 1 MOTOR-DRIVEN AUX FEED PUMP PER UNIT	2 DIESELS PER UNIT

TABLE 6 (CONT.)

PLANT	POWER (MW)	LOOPS	CONTAINMENT	DHRS DIFFERENCES	COMMENTS
SALEM 1,2	3338	4	DRY	3 AUX FEED TRAINS AUX FEED FROM RWST, SERV. WATER FIRE PROT. AND AUX FEED STORAGE	
TROJAN	3411	4	DRY	1 DIESEL DRIVEN AUX FEED PUMP	THIRD AUX FEED TRAIN BEING ADDED
CALLAWAY 1,2	3425	4	DRY		
COMMANCHE PEAK 1,2	3425	4	DRY		
MCGUIRE 1,2	3425	4	ICE CONDENSER		

TABLE 7

PRELIMINARY DHRS GROUPING
WESTINGHOUSE GROUP #3

PLANT	POWER (MW)	LOOPS	CONTAINMENT	DHRS DIFFERENCES	COMMENTS
SURRY (REPEATED)	2441	3	DRY SUB ATMOS	REFERENCE PLANT	RSS PLANT
PRAIRIE I. 1,2	1650	2	DRY	1 AUX FEED MOTOR AUX FEED FROM CST AND SERV. WATER	2 DIESELS PER UNIT
KEWAUNEE	1650	2	DRY	AUX FEED FROM CST AND SERV. WATER	2 DIESELS PER UNIT
POINT BEACH 1,2	1518	2	DRY	1 AUX FEED MOTOR AUX FEED TRAINS HAVE COMMON PIPING AUX FEED FROM CST AND SERV. WATER	1 DIESEL PER UNIT
GINNA	1520	2	DRY	3 AUX FEED TRAINS MANUAL ACTUATION OF STANDBY AUX FEED MOTOR AUX FEED FROM CST, SERV. WATER AND CON-DENSER HOTWELL	2 DIESELS PER UNIT SEP PLANT
TURKEY POINT 3,4	2200	3	DRY	2 HPI PUMPS PER PLANT 3 AUX FEED TRAINS 3 AUX FEED TURBINE PUMPS AUX FEED FROM CST ONLY	1 DIESEL PER UNIT
ROBINSON	2200	3	DRY	AUX FEED FROM CST, SERV. WATER AND DEEP WELL NO AUX FEED FROM SISTER PLANT	2 DIESELS PER UNIT

TABLE 8

PRELIMINARY DHRS GROUPING
WESTINGHOUSE GROUP #4 MISCELLANEOUS PLANTS

PLANT	POWER (MW)	LOOPS	CONTAINMENT	DHRS DIFFERENCES	COMMENTS
HADDAM NECK	1825	4	DRY	2 AUX FEED TURBINES NO AUX FEED MOTORS MANUAL AUX FEED ACTUATION AUX FEED FROM RWST ONLY	2 DIESELS PER UNIT SEP PLANT
SAN ONOFRE 1	1347	3	DRY	1 AUX FEED MOTOR (MANUAL) 1 AUX FEED TRAIN AUX FEED FROM CST, SERV. WATER, FIRE PROT.	2 DIESELS PER UNIT SEP PLANT
YANKEE ROWE	600	4	DRY	2 AUX FEED MOTORS	SEP PLANT

TABLE 9

DHR SYSTEMS DATA FOR GENERAL ELECTRIC PLANTS IN GROUP #1

	DRESDEN 1	BIG ROCK POINT	NINE MILE POINT 1	OYSTER CREEK
CORE MWT	700	240	1850	1930
BWR TYPE	1	1	2	2
JET PUMPS	NO	NO	NO	NO
CONTAINMENT TYPE	DRY	DRY	MK-1	MK-1
# RELIEF VALVES	10	8	6	5
# SAFETY VALVES	?	6	15	16
ISOLATION COND.				
# Installed	1	1	2	2
Capacity	100%	100%	100% Each	100% Each
Makeup Water	Demin Water	Fire or Demin Water	Gravity Feed Tanks or CST	Storage tank or pond
Power	DC	DC	DC, NOTE: Makeup requires AC (D.G.) for cond. trans. pump or a diesel driven fire Pump.	DC, NOTE: Makeup requires AC (D.G.) for cond. trans. pump or one of two diesel driven fire pumps.
HPCI				
# Pumps	2	Not Installed	Not Installed	Not Installed
Suction	HPCI Storage Tank			
Power	DC, AC (DG)			

TABLE 9 (CONT.)

	DRESDEN 1	BIG ROCK POINT	NINE MILE POINT 1	OYSTER CREEK
FWCI				
# Pumps	*	Not	2	2
Capacity	*	Installed	Elec. pump-25,000GPM 700psig Turb. pump-11,000GPM @ 700psig	7000GPM @ 700psig
Power	* NOTE: FWCI is not a safety system		AC or Steam NOTE: FWCI is not a safety system.	AC NOTE: FWCI is not a safety system.
LOW PRESS CORE SPRAY				
# Pumps	3	2	8 (4 sets of main/ topping pumps)	8 (4 sets of main/ booster pumps)
Capacity	*	*	4-100% trains, 3400 GPM @ 113psid	4-100% trains, 3400 GPM @ 285psid
Suction	Lake or river	Lake or river	Supp. pool	Supp. pool
Power	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)
Support	*	*	*	RBCLCW-room coolers NOTE: two 2000GPM fire pumps provide a backup to core spray.
ADS				
# Valves	*	8 reliefs used	6 reliefs used (3 required)	5 reliefs used
Power	DC	DC	DC	DC

TABLE 9 (CONT.)

	DRESDEN 1	BIG ROCK POINT	NINE MILE POINT 1	OYSTER CREEK
SHUTDOWN COOLING				
# Pumps	*	2	3	3
# Heat Exchangers	*	2	3	3
Capacity	*	*	*	*
Power	Offsite AC	AC (DG)	AC (DG)	AC
Support	CCW, Plant Air	RCWS NOTE: Shutdown cooling is not a safety system	RBCCWS-Pump coolers and heat exchangers	RBCLCW-Pump coolers and heat exchangers
REACTOR VESSEL HEAD SPRAY COOLING	Not Installed	Not Installed	Not Installed	YES
SUPP. POOL COOLING				
# Pumps	Has Dry Containment	Has Dry Containment	4	4
# Heat Exchangers			4	*
Capacity			Two 100% Loops	Two 100% Loops
Power			AC (DG)	AC
Support			RW-Cools heat exchangers	*
DIESEL GENERATORS	YES	1 (plus 1 portable)	2 (Need 1)	3

TABLE 9 (CONT.)

	DRESDEN 1	BIG ROCK POINT	NINE MILE POINT 1	OYSTER CREEK
SUPPORT SYSTEMS	*	1) SW-2 Pumps. Requires offsite AC power. Cools RCWS.	1) SW-2 100% Pumps, 20,000 GPM each. Cools RBCCWS.	1) 2 Pumps. Cools RBCLCW.
		2) RCWS-Cools the Reactor Shutdown Cooling heat exchangers.	2) ESW-2 100% Pumps, 3600 GPM each. Cools RBCCWS on loss of offsite AC.	2) RBCLCW-1 main and 1 booster pump. 3400 GPM. Cools Core Spray pump room, Reactor Shutdown Cooling pumps and heat exchangers.
			3) RBCCWS-3 Pumps and 3 exchangers each 50% capacity, 4500GPM per pump. Cools Reactor Shutdown Cooling pumps and heat exchangers	3) Fire Water System- This is a backup supply for makeup water to the iso. cond.
			4) Containment Spray Heat Exchangers Raw Water Pumps-AC (D.G.). Cools supp. pool cooling heat exchangers.	
			5) Fire Water System - This is a backup supply for makeup water to the iso. cond. diesel driven pump rated at 2500GPM, 125psig.	

* - INFORMATION NOT CURRENTLY AVAILABLE.

TABLE 10

DHR SYSTEMS DATA FOR GENERAL ELECTRIC PLANTS IN GROUP #2

	MILLSTONE 1	DRESDEN 2&3
CORE MWT	2011	2527
BWR TYPE	3	3
JET PUMPS	YES	YES
CONTAINMENT TYPE	MK-1	MK-I
# RELIEF VALVES	3	5
# SAFETY VALVES	16	20
ISOLATION COND.		
# Installed	*	1
Capacity	*	100%
Makeup Water	CST, Fire water storage tanks.	CST, Fire Protection Storage Tanks
Power	DC. NOTE: Makeup requires AC for cond. tran. pumps or a diesel driven fire pump.	DC. NOTE: Makeup requires AC (D.G.) for cond. trans. pumps or a diesel driven fire pump.
HPCI		
# Pumps		2 (One main, one booster).
Capacity	Not	5600GPM @ 165 to 1135psid.
Suction	Installed	CST, supp. pool.
Power		DC, Steam.

TABLE 10 (CONT.)

	MILLSTONE 1	DRESDEN 2&3
FWCI		
# Pumps	3 Sets of cond., cond. booster, and FW Pumps	Not Installed
Capacity	Each set 100%, 8000GPM @ 100 to 1125psid.	
Power	AC (Gas T.G.)	
Support	TBSCWS - Cools pumps NOTE: This is a safety system	
LPCI		
# Pumps	4 (33% each)	4 (33% each)
# Heat Exchangers	2	2
Capacity	7500GPM @ 165psid, 15000GPM @ Opsid for 3 out of 4 pumps.	8000GPM @ 200psid for 3 out of 4 pumps.
Suction	Supp. pool	Supp. Pool
Power	AC (D.G. or gas T.G.)	AC (D.G.)
Support	ESW-Cools heat exchangers.	ESW-Cools heat exchangers.
LOW PRESS. CORE SPRAY		
# Pumps	2 100% Loops	2 (100% each)
Capacity	3600GPM @ 90psid	4500GPM @ 90psid
Suction	Supp. pool	Supp. Pool
Power	AC (D.G. or gas T.G.)	AC (D.G.)
Support	*	*

TABLE 10 (CONT.)

	MILLSTONE 1	DRESDEN 2&3
ADS		
# Valves	*	5 Reliefs used
Power	DC	DC
SUPP. POOL COOLING		
Description	Uses LPCI pumps and heat exchangers with only one pump and heat exchanger required.	Uses LPCI pumps and heat exchangers.
Support	ESW-Cools heat exchangers.	ESW-Cools heat exchangers.
SHUTDOWN COOLING		
# Pumps	2	3
# Heat Exchangers	2	3
Capacity	2900GPM per pump	6750GPM per pump
Power	AC	AC
Support	RBCLCW-Cools heat exchangers.	RBCLCW-Cools pumps and heat exchangers.
REACTOR VESSEL HEAD COOLING		
# Pumps	2	2 (100% each)
Capacity	*	170GPM per pump
Suction	CST	CST
Power	AC	AC
DIESEL GENERATORS	1 D.G. and 1 air cooled gas T.G.	3 (1 DED per unit, 1 shared) only need 1 per unit.

TABLE 10 (CONT.)

	MILLSTONE 1	DRESDEN 2&3
SUPPORT SYSTEMS	1. Station SW-4 pumps, 10,000GPM. AC (D.G.). Cools D.G., RBCLCW, and TBSCWS heat exchangers.	1. SW-3 pumps, 15,000GPM each. AC (D.G.). Cools RBCLCW.
	2. ESW-4 50% pumps, 2500GPM @ 425 ft. TDH each. AC (D.G. or gas T.G.). Cools LPCI heat exchangers.	2. ESW-4 50% pumps, 3500GPM @ 435 ft. TDH each. AC (D.G.). Cools LPCI Heat exchangers.
	3. RBCLCW-2 pumps, 3 heat exchangers. 4200GPM per pump. Cools shutdown cooling pumps and heat exchangers.	3. RBCLCW-3 pumps. 8800GPM per pump. Cools shutdown cooling pumps and heat exchangers.
	4. TBSCWS-2 pumps, 100% each and 2 heat exchangers, 50% each. 1800GPM per pump. Cools FWCI pumps.	4. Fire Protection System-This is a backup supply for makeup water to the iso. cond. Uses a diesel driven pump.
	5. Fire Protection System-This is a backup supply for makeup water to the iso. cond. Uses a diesel driven pump.	
	* INFORMATION NOT CURRENTLY AVAILABLE.	

TABLE 11

DHR SYSTEMS DATA FOR GENERAL ELECTRIC PLANTS IN GROUP #3

	PEACH BOTTOM 2&3	PILGRIM	MONTICELLO	QUAD CITIES 1&2	VERMONT YANKEE	BROWNS FERRY 1,2&3
CORE MWT	3293	1998	1670	2511	1593	3293
BWR TYPE	4	3	3	3	4	4
JET PUMPS	YES	YES	YES	YES	YES	YES
CONTAINMENT TYPE	MK-I	MK-I	MK-I	MK-I	MK-I	MK-I
# RELIEF VALVES	11	3	4 (SRV's)	5	4	11 (SRV's)
# SAFETY VALVES	2	2	4	8	2	2
RCIC						
# Pumps	1	1	1	1	1	1
Capacity	600GPM from 525 to 2800 ft TDH	400GPM from 525 to 2800 ft TDH	400GPM from 525 to 2800 ft TDH	525GPM from 525 to 2800 ft TDH	400GPM from 525 to 2800 ft TDH	616GPM @ 1120 psid
Suction	CST, Supp. Pool	CST, Supp. Pool	CST, Supp. Pool	CST, Supp. Pool	CST, Supp. Pool	CST, Supp. Pool
Power	DC	DC	DC	DC	DC	DC
Support	*	RBCLCW-area cooler	ESW-area cooler	*	*	*
HPCI						
# Pumps	one main, one booster	one main, one booster	one main, one booster	one main, one booster	one main, one booster	one main, one booster
Capacity	5000GPM @ 1120psid	4250GPM from 135 to 1135psid	3000GPM from 135 to 1135psid	5600GPM from 150 to 1125psid	4250GPM @ 1120psid	5000GPM @ 1120psid
Suction	CST with auto-transfer to supp. pool	CST with auto-transfer to supp. pool	CST with auto-transfer to supp. pool	CST with auto-transfer to supp. pool	CST with auto-transfer to supp. pool	CST with auto-transfer to supp. pool
Power	DC	DC	DC	DC	DC	DC
Support	*	RBCLCW-area cooler	ESW-area cooler	*	*	*

TABLE 11 (CONT.)

	PEACH BOTTOM 2&3	PILGRIM	MONTICELLO	QUAD CITIES 1&2	VERMONT YANKEE	BROWNS FERRY 1,2&3
LPCI						
# Pumps	4 (part of RHR)	4 (part of RHR)	4 (part of RHR)	4 (part of RHR)	4 (part of RHR)	4 (part of RHR)
Capacity	10,000GPM @ 20 psid each	4800GPM @ 20 psid each	4000GPM @ 20 psid each	4830GPM @ 20 psid each	7200GPM @ 20 psid each	10,000GPM @ 20 psid each
Suction	Supp. pool	Supp. pool	Supp. pool	Supp. pool	Supp. pool	Supp. pool
Power	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)
Support	*	RHRSW cools heat exchanger; RBCLCW cools pumps and area coolers	RHRSW cools heat exchanger; RBCLCW cools pump seals; ESW cools pump motors	RHRSW cools heat exchanger	RHRSW cools heat exchanger; RBCLCW cools pump cooler	RHRSW cools pump room coolers and heat exchangers
LOW PRESS. CORE SPRAY						
# Pumps	4	2 (100% each)	2 (100% each)	2 (100% each)	2 (100% each)	2 (100% each)
Capacity	3125GPM @ 122 psid each	3600GPM @ 104 psid each	3020GPM @ 307 psid each	4500GPM @ 90 psid each	3000GPM @ 120 psid each	3125GPM @ 122 psid each
Suction	Supp. pool	Supp. pool	Supp. pool	Supp. pool	Supp. pool	Supp. pool
Power	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)
Support	*	RBCLCW-cools pump bearings	ESW-cools pump motor	*	RBCLCW-cools pump coolers	RHRSW-cools pump coolers
ADS						
# Valves	5 reliefs used	3 reliefs used	3 SRV's (need 2)	*	4 reliefs used	*
Power	DC	DC	DC	DC	DC	DC
SUPP. POOL COOLING						
Description	Uses RHR pumps and heat exchangers	Uses RHR pumps and heat exchangers	Uses RHR pumps and heat exchangers	Uses RHR pumps and heat exchangers	Uses RHR pumps and heat exchangers	Uses RHR pumps and heat exchangers
Support	High press. SW cools heat exchangers	RHRSW cools heat exchangers; RBCLCW cools pumps and area coolers	RHRSW cools heat exchangers; RBCLCW cools pump seals; ESW cools pump motors	RHRSW cools heat exchangers	RHRSW cools heat exchangers; RBCLCW cools pump coolers	RHRSW cools pump room coolers and heat exchangers

TABLE 11 (CONT.)

	PEACH BOTTOM 2&3	PILGRIM	MONTICELLO	QUAD CITIES 1&2	VERMONT YANKEE	BROWNS FERRY 1,2&3
RHR						
# Pumps	4	4	4	4	4	4
# Heat Exchangers	4	2	2	2	2	4
Capacity	10,000GPM @ 20 psid each	4800GPM @ 20 psid each	4000GPM @ 20 psid each	4830GPM @ 20 psid each	7200GPM @ 20 psid each	10,000GPM @ 20 psid each
Power	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)
Support	High press. SW cools heat exchangers	RBCLCW cools heat exchangers, pump cooler, area cooler	RHRSW cools heat exchangers; RBCLCW cools pump seals; ESW cools pump motors	RHRSW cools heat exchangers	RHRSW cools heat exchangers; RBCLCW cools pump coolers	RHRSW cools heat exchangers
DIESEL GENERATORS	4 (2 per unit)	2	2	3 (1 DED per unit, one shared)	2	Units 1 & 2 share 4 D.G.(2 per unit) Unit 3 - 4 D.G.
SUPPORT SYSTEMS	1) High Press. SW cools RHR heat exchangers	1) RHRSW cools RHR heat exchanger. AC (D.G.) 2) Salt SW-5 pumps rated at 2700GPM, 55 ft. TDH each. Cools RBCLCW heat exchangers. 3) RBCLCW-Two 100% loops with 3 pumps per loop. 1700GPM @ 100 ft. TDH each pump. Each loop has 1 heat exchanger. AC (D.G.) Cools RHR heat exchangers, RHR pumps and area coolers, HPCI and	1) RHRSW-4 pumps in two trains of 2 pumps. 50% capacity per pump. Supplies PHR heat exchangers. 2) Plant SW - This is not a safety system. Three 50% capacity pumps. Cools RBCLCW heat exchangers. 3) ESW-Cools D.G.'s and RHR pump motor. 4) RBCLCW-Two 100% pumps with three 50% heat exchangers. Cools RHR pump seals.	1) RHRSW-4 pumps 7000GPM @ 750 ft TDH TDH each. AC (D.G.) cools RHR heat exchanger.	1) RHRSW-2 main and 2 booster pumps, 2700GPM per pump. one main and one booster are 100% capacity. AC (D.G.) Supplies RHR heat exchangers. 2) SW-4 pumps, 3350 GPM @ 250 ft TDH each. AC(D.G.) Cools RBCLCW heat exchangers and diesel generator. 3) RBCLCW-Two 100% pumps and heat exchangers rated at 2200GPM @ 170 ft.	1) RHRSW-8 pumps shared between the 3 plants. 4500GPM per pump.

TABLE 11 (CONT.)

	PEACH BOTTOM 2&3	PILGRIM	MONTICELLO	QUAD CITIES 1&2	VERMONT YANKEE	BROWNS FERRY 1,2&3
SUPPORT SYSTEMS (Cont'd)		RCIC area coolers, and core spray pump bearings.			TDH. AC (D.G.) Cools RHR and core spray pump coolers. Note: RHRSW pump suction from the SW system or Alternate Cooling Water System. This alternate supply is used if Vernon Dam fails. It supplies the RHR pumps from cooling towers for up to one week.	

*Information not currently available.

TABLE 12

DHR SYSTEMS DATA FOR GENERAL ELECTRIC PLANTS IN GROUP #4

	LIMERICK 1	HATCH 1&2	COOPER	DUANE ARNOLD	FITZPATRICK	BRUNSWICK 1&2	SHOREHAM
CORE MWT	3293	2436	2381	1658	2436	2436	2436
BWR TYPE	4	4	4	4	4	4	4
JET PUMPS	YES	YES	YES	YES	YES	YES	YES
CONTAINMENT TYPE	MK-II	MK-I	MK-I	MK-I	MK-I	MK-I	MK-II
# RELIEF VALVES	14(SRV'S)	Unit 1-11(SRV'S) Unit 2-9	8	6	9(SRV'S)	Unit 1-9(SRV'S) Unit 2-10(SRV'S)	11(SRV'S)
# SAFETY VALVES	NONE	Unit 1 - None Unit 2 - 2	3	2	2	2	NONE
RCIC							
# Pumps	1	1	1	1	1	1	1
Capacity	625GPM from 585 to 2800 ft TDH	400GPM @ 1140 psid	400GPM from 525 to 2800 ft TDH	400GPM from 525 to 2800 ft TDH	400GPM	400GPM from 525 to 2800 ft TDH	425GPM @ 1135psid
Suction	CST, Supp. Pool or RHR heat exchanger for steam condensing Mode.	CST, Supp. Pool or RHR heat exchanger for steam condensing Mode.	CST, Supp. Pool or RHR heat exchanger for steam condensing Mode.	CST, Supp Pool or RHR heat exchanger for steam condensing Mode	CST, Supp Pool or RHR heat exchanger for steam condensing Mode.	CST, Supp Pool or RHR heat exchanger for steam condensing Mode.	CST, Supp Pool or or RHR heat exchanger for steam condensing Mode
Power	DC	DC	DC	DC	DC	DC	DC
Support	ESW-Area Coolers	Plant SW-Area Cooler	RBCLCW-Area Cooler	ESW-Area Coolers	*	*	*
HPCI							
# Pumps	one main, one booster	one main, one booster	one main, one booster	one main, one booster	one main, one booster	one main, one booster	one main, one booster
Capacity	5600GPM	4250GPM from 150 to 1140psid	4250GPM from 150 to 1140psid	3000GPM from 150 to 1120psid	4250GPM from 150 to 1120psid	4250GPM from 150 to 1120psid	4250GPM from 150 to 1105psid
Suction	CST with auto-transfer to supp. pool	CST with auto-transfer to supp. pool	CST with auto-transfer to supp. pool	CST with auto-transfer to supp. pool	CST with auto-transfer to supp. pool	CST with auto-transfer to supp. pool	CST with auto-transfer to supp. supp. pool
Power	DC	DC	DC	DC	DC	DC	DC
Support	ESW - area coolers	Plant SW - area coolers	RBCLCW - area coolers	ESW - area coolers	*	*	*

TABLE 12 (CONT.)

	LIMERICK 1	HATCH 1&2	COOPER	DUANE ARNOLD	FITZPATRICK	BRUNSWICK 1&2	SHOREHAM
LPCI							
# Pumps	4	4	4	4	4	4	4
Capacity	10,000GPM @ 20 psid each	7700GPM @ 395 ft TDH each	7700GPM @ 20 psid each	4800GPM @ 20 psid each	7710GPM @ 20 psid each	7700GPM @ 20 psid each	7700GPM @ 20psid each
Suction	Supp. Pool	Supp. Pool	Supp. Pool	Supp Pool	Supp Pool	Supp Pool	Supp Pool
Power	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)
Support	EWS-cools pump seals, pump cooler & area coolers	Plant SW - pump seal & area coolers	RBCLCW - area & pump lube oil coolers	ESW - cools area and pump motor coolers	ESW - Pump area & pump coolers	Nuclear SW - room coolers	RBCLCW - pump seal coolers CRAC/RBSVS - area coolers
LOW PRESS. CORE SPRAY							
# Pumps	4 (50% each)	2 (100% each)	2 (100% each)	2 (100% each)	2 (100% each)	2 (100% each)	2 (100% each)
Capacity	6350GPM @ 105 psid	4275GPM	4500GPM @ 113 psid	3020GPM @ 113 psid	4625GPM @ 113 psid	4700GPM @ 113 psid	4725GPM @ 113psid
Suction	Supp. Pool	Supp. Pool	Supp. Pool	Supp. Pool	Supp. Pool	Supp. Pool	Supp. Pool
Power	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)
Support	ESW - area coolers	Plant SW - area coolers	RBCLCW - area coolers	ESW - pump bearing & room coolers	*	Nuclear SW - room coolers	CRAC/RBSVS - area coolers
ADS							
# Valves	5 (SRV's)	7 (20% each)	6 (20% each)	4 (33 1/3% each)	6 (20% each)	7 (16.7% each)	7 (SRV's)
Power	DC	DC	DC	DC	DC	DC	DC
SUP. POOL COOLING							
Description	Uses RHR pumps & heat exchangers	Uses RHR pumps & heat exchangers	Uses RHR pumps & heat exchangers	Uses RHR pumps & heat exchangers	Uses RHR pumps & heat exchangers	Uses RHR pumps & heat exchangers	Uses RHR pumps & heat exchangers changers
Support	RHRSW - Cools heat exchangers ESW - Cools pump seal, pump cooler & area coolers	RHRSW - Cools heat exchangers Plant SW - Cools pumps & pump area coolers	RHRSW - Cools heat exchangers RBCLCW - Cools areas & pump lube oil coolers	RHRSW - Cools heat exchangers ESW - Cools area & pump motor coolers	RHRSW - Cools heat exchangers ESW Cools pump & pump area coolers	RHRSW - Cools heat exchangers Nuclear SW - room coolers	SW - Cools heat exchangers CRAC/RBSVS - area coolers

TABLE 12 (CONT.)

	LIMERICK 1	HATCH 1&2	COOPER	DUANE ARNOLD	FITZPATRICK	BRUNSWICK 1&2	SHOREHAM
RHR							
# Pumps	4	4	4	4	4	4	4
# Heat Exchangers	2	2	2	2	2	2	2
Capacity	10,000GPM @ 20 psid each	7700GPM @ 20 psid each	7700GPM @ 20 psid each	4800GPM @ 20psid each	7710GPM @ 20 psid each	7700GPM @ 20psid each	7700GPM @ 20psid
Power	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)	AC (D.G.)
Support	RHRSW - Cools heat exchangers ESW - Cools pump seals, pump coolers & area coolers	RHRSW - Cools heat exchangers Plant SW - Cools pump seal & area coolers	RHRSW - Cools heat exchangers RBCLCW - Cools area & pump lube oil coolers	RHRSW - Cools heat exchangers ESW - Cools pump seals, motor and room coolers	RHRSW - Cools heat exchangers ESW - Cools pump & area coolers	RHRSW - Cools heat exchangers Nuclear SW - room coolers	SW - Cools heat exchangers RBCLCW - Cools pump seals CRAC/RBSVS - cools room coolers
DIESEL GENERATORS	8 (4 each for Units 1 & 2)	5 (2 DED per plant, one shared)	2	2	4	4	3
SUPPORT SYSTEMS	1) RHRSW - 2 loops. Each loop serves 1 RHR heat exchanger. This system is shared between Units 1 and 2.	1) RHRSW - 4 50% capacity pumps rated 4000GPM @ 955 ft TDH each. AC (D.G.). Cools RHR heat exchangers.	1) SW - 4 pumps. 8000GPM @ 125 ft TDH each. Cools RBCLCW & D.G. heat exchangers.	1) RHRSW - 4 50% pumps rated 2400 GPM @ 674 ft TDH Cools RHR heat exchangers.	1) RHRSW - 4 50% pumps rated 4000 GPM @ 267 ft TDH Cools RHR heat exchangers.	1) RHRSW - 4 50% pumps rated 4000 GPM @ 570 ft TDH each. Cools RHR heat exchangers.	1) SW - 4 33% pumps rated 8600 GPM @ 64psig. Cools RHR, RBCLCW, RBSVS/CRAC heat exchangers and D.G.'s.
	2) SW - 3 pumps rated 12000 GPM each. Not safety related. ESW supplies safety loads on loss of AC. Can cross connect between plants	2) Plant SW - 4 33 1/3% capacity pumps rated 8500 GPM @ 275 ft TDH each. Cools ECCS pumps, ECCS pump areas & 4 of the 5 D.G.'s.	2) RHRSW Booster Pumps - 4 pumps rated 4000GPM @ 800 ft TDH. 2 loops with 2 pumps per loop. Each loop has 100% capacity. Cools RHR heat exchangers.	2) ESW - 2 100% pumps rated 1200 GPM @ 170 ft TDH. Cools ECCS pumps and area coolers and D.G.'s.	2) ESW - 2 100% pumps rated 3700 GPM @ 168 ft TDH Cools ECCS pumps and area coolers and D.G.'s	2) Nuclear SW - 2 100% pumps rated 8000GPM @ 115 ft TDH. Cools ECCS pumps and area coolers and D.G.'s.	2) RBCLCW - 3 50% pumps & 2 100% heat exchangers. 1600GPM per pump. Cools ECCS pump seals.

TABLE 12 (CONT.)

	LIMERICK 1	HATCH 1&2	COOPER	DUANE ARNOLD	FITZPATRICK	BRUNSWICK 1&2	SHOREHAM
SUPPORT SYSTEMS (Cont'd)	3) ESW - 2 100% loops with 2 50% capacity pumps per loop. Cools ECCS pumps, pump areas and the diesel generators. This system is shared between Units 1 and 2.	3) Standby Diesel SW pump - 1 pump rated 700GPM @ 230 ft TDH. Cools the shared D.G.	3) RBCLCW - 2 pumps & 2 heat exchangers each rated at 100% capacity. 1350 GPM @ 150 ft TDH. Cools ECCS area and pump coolers.				3) RBSVS/CRAC - 2 100% systems. Cools ECCS pumps and area coolers.

*Information not currently available.

TABLE 13

DHR SYSTEMS DATA FOR GENERAL ELECTRIC PLANTS IN GROUP #5

	GRAND GULF 1	ZIMMER	LASALLE 1 & 2
CORE MWT	3833	2436	3293
BWR TYPE	6	5	5
JET PUMPS	YES	YES	YES
CONTAINMENT TYPE	MK-III	MK-II	MK-II
# RELIEF VALVES	22(SRV's)	13(SRV's)	11(SRV's)
# SAFETY VALVES	NONE	NONE	6
RCIC			
# Pumps	1	1	1
Capacity	800GPM @ 1120psid	400GPM @ 1120psid	625GPM @ 1120 psid
Suction	CST, Supp. Pool or RHR heat exch. in steam Condensing Mode.	CST, Supp. Pool or RHR heat exch. in steam Condensing Mode.	CST, Supp. Pool or RHR heat exch. in steam Condensing Mode
Power	DC	DC	DC
Support	Standby SW-Cools pump room	RBCLCW - area cooler	*
HIGH PRESSURE CORE SPRAY			
# Pumps	1	1	1
Capacity	1500GPM @ 1130psid, 7000GPM @ 200psid	1330GPM @ 1110psid, 4725GPM @ 200psid	1650GPM @ 1130psid 6250GPM @ 200psid
Suction	CST with auto transfer to Supp. Pool	CST with auto transfer to Supp. Pool	CST with auto transfer to Supp. Pool
Power	AC (D.G.)	AC (D.G.)	AC (D.G.)
Support	HPCS SW - Cools pump room, pump cooler, and HPCS D.G.	RBCLCW - area cooler	*

TABLE 13 (CONT.)

	GRAND GULF 1	ZIMMER	LASALLE 1 & 2
RHR			
# Pumps	3	3	3
# Heat Exchangers	2 (only 2 pumps can pass water through heat exchangers)	2 (only 2 pumps can pass water through heat exchangers)	2 (only 2 pumps can pass water through heat exchangers)
Capacity	7450GPM @ 20psid each	5050GPM @ 20psid each	7450GPM @ 20psid each
Power	AC (D.G.)	AC (D.G.)	AC (.D.G.)
Support	Standby SW-Cools heat exchanger and pump coolers	RBCLCW - Cools pumps and room coolers, SW-Cools heat exchangers	RHRSW - Cools heat exchangers
DIESEL GENERATORS	3 (plus a HPCS Pump D.G.)	3	5 (2 DED per plant, 1 shared)
SUPPORT SYSTEMS	1) Standby SW - Two 100% pumps rated 11000GPM @ 150 ft. TDH each. Cools ECCS pump and area coolers, RHR heat exchangers and diesel generators. 2) HPCS SW - One pump rated 1000GPM @ 150 ft TDH. Cools HPCS D.G.	1) SW - Four pumps rated 12,500GPM @ 295 ft TDH each. Cools RHR and RBCLCW heat exchangers and D.G.'s. 2) RBCLCW - Four pumps and three heat exchangers in a 2 loop configuration. Each loop has 2 pumps and 1 heat exchanger with one shared heat exchanger. 2640GPM @ 96 ft. TDH each pump. Cools ECCS pumps and area coolers	1) RHR SW - 4 pumps rated 7400GPM each. Cools RHR heat exchangers.

*Information not currently available

TABLE 13 (CONT.)

	GRAND GULF 1	ZIMMER	LASALLE 1 & 2
LPCI			
# Pumps	3	3	3
Capacity	7450GPM @ 20psid each	5050GPM @ 20psid each	7450GPM @ 20psid each
Suction	SUPP. POOL	SUPP. POOL	SUPP. POOL
Power	AC (D.G.)	AC (D.G.)	AC (.D.G.)
Support	Standby SW-Cools pump coolers and heat exchanger.	RBCLCW - Cools pumps and room coolers, SW - cools heat exchanger	RHRSW - Cools Heat Ex-exchangers
LOW PRESSURE CORE SPRAY			
# Pumps	1	1	1
Capacity	7000GPM @ 122psid	4625GPM @ 119psid,	6250GPM @ 125psid
Suction	Supp. Pool	Supp. Pool	Supp. Pool
Power	AC (D.G.)	AC (D.G.)	AC (D.G.)
Support	Standby SW - Cools pump and room coolers	RBCLCW - cools room cooler	*
ADS			
Valves	8(SRV's)	6(SRV's)	7(SRV's)
Power	DC	DC	DC
Supp. Pool Cooling			
Description	Uses RHR pumps and heat exchangers.	Uses RHR pumps and heat exchangers.	Uses RHR pumps and heat exchangers.
Support	Standby SW - Cools pumps and heat exchangers	SW - Cools heat exchangers RBCLCW - Cools pumps and room coolers.	RHRSW - Cools heat exchangers

TABLE 14

ABBREVIATIONS FOR GE GROUPINGS

AC (D.G.)	AC power offsite, or diesel generator
ADS	Automatic Depressurization System
CCW	Component Cooling Water
CRAC/RBSVS	Control Room Air Conditioning/Reactor Building Standby Ventillation System
DG	Diesel Generator
ECCS	Emergency Core Cooling System
ESW	Emergency Service Water
FW	Feedwater
FWCI	Feedwater Coolant Injection
HPCI	High Pressure Coolant Injection
HPCS	High Pressure Core Spray
LPCI	Low Pressure Coolant Injection
RBCCWS	Reactor Building Cooling Water System
RBCLCW	Reactor Building Closed Loop Cooling Water
RCIC	Reactor Core Isolation Cooling
RCWS	Reactor Cooling Water System
RHR	Residual Heat Removal
RW	Raw Water
SW	Service Water
TBSCWS	Turbine Building Secondary Cooling Water System
TG	Turbine Generator

TABLE 15

PRELIMINARY DHRS GROUPING
GENERAL ELECTRIC GROUP #1

PLANT	POWER (MWT)	CONTAINMENT	DHRS DIFFERENCES	COMMENTS
BIG ROCK POINT	240	DRY	REFERENCE PLANT	INDUSTRY PRA SEP PLANT
DRESDEN 1	700	DRY	HAS 2 HPCI PUMPS HAS 3 CORE SPRAY PUMPS	SHUTDOWN COOLING REQUIRES OFFSITE AC.
NINE MILE POINT 1	1850	MK-1	HAS 2 INSTEAD OF 1 ISO. COND. HAS 4 TRAINS OF CORE SPRAY INSTEAD OF 2 CORE SPRAY PUMPS. HAS 2 FWCI PUMPS.	
OYSTER CREEK	1930	MK-1	HAS 2 INSTEAD OF 1 ISO. COND. HAS REAC. VESSEL HEAD SPRAY COOLING. HAS 4 TRAINS OF CORE SPRAY INSTEAD OF 2 CORE SPRAY PUMPS. HAS 2 FWCI PUMPS.	SEP PLANT

NOTE: THESE PLANTS DO NOT HAVE JET PUMPS INSTALLED. FWCI SYSTEMS ARE NOT SAFETY RELATED.

TABLE 16

PRELIMINARY DHRS GROUPING
GENERAL ELECTRIC GROUP #2 SIMILAR TO MILLSTONE (IREP)

PLANT	POWER (MWT)	CONTAINMENT	DHRS DIFFERENCES	COMMENTS
MILLSTONE 1	2011	MK-I	REFERENCE PLANT	SEP PLANT
DRESDEN 2&3	2527	MK-I	HAS A HPCI SYSTEM INSTEAD OF FWCI. HAS 3 REACTOR SHUTDOWN COOLING SYSTEM PUMPS AND HEAT EXCHANGERS INSTEAD OF 2.	SEP PLANT

TABLE 17

PRELIMINARY DHRS GROUPING
GENERAL ELECTRIC GROUP #3 SIMILAR TO PEACH BOTTOM (RSS)

PLANT	POWER (MWT)	CONTAINMENT	DHRS DIFFERENCES	COMMENTS
PEACH BOTTOM 2&3	3293	MK-I	REFERENCE PLANT	
MONTICELLO	1670	MK-I		
QUAD CITIES 1&2	2511	MK-I	THESE PLANTS HAVE 2 CORE SPRAY PUMPS INSTEAD OF 4 AND 2 RHR HEAT EXCHANGERS INSTEAD OF 4.	
PILGRIM	1998	MK-I		
VERMONT YANKEE	1593	MK-I		
BROWNS FERRY 1,2&3	3293	MK-I	HAS 2 CORE SPRAY PUMPS.	PRA (IREP, INDUSTRY)

TABLE 18

PRELIMINARY DHRS GROUPING
GENERAL ELECTRIC GROUP #4 SIMILAR TO LIMERICK (INDUSTRY PRA)

PLANT	POWER (MWT)	CONTAINMENT	DHRS DIFFERENCES	COMMENTS
LIMERICK 1	3293	MK-II	REFERENCE PLANT	TO BE LICENSED IN 1985
HATCH 1 & 2	2436	MK-I		
COOPER	2381	MK-I		
DUANE ARNOLD	1658	MK-I		
FITZPATRICK	2436	MK-I		
BRUNSWICK 1 & 2	2436	MK-I		
SHOREHAM	2436	MK-II		TO BE LICENSED IN 1983 INDUSTRY PRA

TABLE 19

PRELIMINARY DHRS GROUPING
GENERAL ELECTRIC GROUP #5 SIMILAR TO GRAND GULF (RSSMAP)

PLANT	POWER (MWT)	CONTAINMENT	DHRS DIFFERENCES	COMMENTS
GRAND GULF 1	3833	MK-III	REFERENCE PLANT	HIGH PRESS. CORE SPRAY PUMP HAS ITS OWN DIESEL GENERATOR. TO BE LICENSED IN 1982.
ZIMMER	2436	MK-II		TO BE LICENSED IN 1982.
LASALLE 1 & 2	3293	MK-II		BOTH PLANTS TO BE LICENSED IN 1982.

TABLE 20

DHR SYSTEMS DATA FOR COMBUSTION ENGINEERING PLANTS IN GROUP #1

	CALVERT CLIFFS 1 & 2	PALISADES	MAINE YANKEE	MILLSTONE #2	ST. LUCIE #1
CORE MWT	2700	2530	2630	2560	2560
NO. LOOPS	2	2	3	2	2
CONTAINMENT TYPE	DRY	DRY	DRY	DRY	DRY
# SAFETY VALVES	2	3	3	2	3
# PORV'S	2	2	2	2	2
HIGH PRESS. SAFETY INJ.					
# Pumps	3 (1/3 REQ'D)	3 (1/3 REQ'D)	3	3 (1/3 REQ'D)	3 (1/3 REQ'D)
Capacity	345GPM @ 2500 ft each	300GPM @ 2500 ft each	150GPM @ 2850psig each	315GPM @ 2500 ft each	345GPM @ 2500 ft each
Suction	RWST with auto-transfer to containment sump.	SIRW Tank with auto-transfer to containment sump.	RWST with auto-transfer to containment sump.	RWST with auto-transfer to containment sump.	RWT with auto-transfer to containment sump.
Power	DG.	DG.	DG.	DG.	DG.
Support	Salt Service Water - Area cooler; CCW - pumps seals.	Service Water - Room cooler; CCW - pump seals (can also be supplied directly from Service Water).	Primary and Secondary CCW - Cools pump motors & oil cooler.	RBCCW - Cools pump seals and area cooler.	CCW - Cools pump seals.
CHARGING SYSTEM					
# Pumps	3	3 (2 fixed, 1 variable capacity)	Uses HPSI Pumps	3	3
Capacity	44GPM @ 2310psig each	Fixed - 40GPM @ 6375 ft. each. Variable - 40GPM @ 230 ft.	150GPM @ 2850psig each	44GPM @ 2310psig each	44GPM @ 2300psig each
Suction	VCT, RWST	VCT	VCT, RWST, Boric Acid Pumps	VCT, RWST, Boric Acid Pumps	VCT, RWT, Boric Acid Pumps
Power	DG.	DG.	DG.	DG.	DG.
			Note: There is also 1 variable capacity auxiliary charging pump (positive displacement) rated at 10 to 30 GPM @ 2300psig. This is for shutdown of an isolated primary loop.		

TABLE 20 (CONT.)

	CALVERT CLIFFS 1 & 2	PALISADES	MAINE YANKEE	MILLSTONE #2	ST. LUCIE #1
LOW PRESS SAFETY INJ.					
# Pumps	2	2	2	2	2
Capacity	3000GPM @ 350 ft each	3000GPM @ 350 ft each	3000GPM @ 350 ft each	3000GPM @ 350 ft each	3000GPM @ 350 ft each
Suction	RWST or Containment sump (LPSI pumps auto-stop on transfer from RWST to sump).	SIRW Tank or Containment Sump (LPSI pumps auto-stop on transfer from SIRW tank to sump).	RWST or Containment sump (LPSI pumps auto-stop on transfer from RWST to sump).	RWST or Containment sump (LPSI pumps auto-stop on transfer from RWST to sump).	RWST or Containment sump (LPSI pumps auto-stop on transfer from RWST to sump).
Power	DG.	DG.	DG.	DG.	DG.
Support	Salt Service Water - Area cooler; CCW - pump seals.	Service Water - Room cooler; CCW - pump seals	CCW - Cools pumps	RBCCW - Cools area coolers & pump seals.	CCW - Cools pump seals.
SHUTDOWN COOLING					
# Pumps	Uses LPSI Pumps	Uses LPSI Pumps	Uses LPSI Pumps	Uses LPSI Pumps	Uses LPSI Pumps
# Heat Exchangers	2	2	2	2	2
Support	Salt Service Water - area cooler; CCW - pump seals & heat exchangers	Service Water - Room cooler; CCW - pump seals and heat exchangers.	CCW - Primary CCW & Secondary CCW cools 1 heat exchanger each. Also cools pumps.	RBCCW - Cools heat exchangers, area coolers, and pump seals.	CCW - Cools pump seals and heat exchangers
AUX. FEEDWATER					
# Pumps	2 Turbine	1 Turbine*/1 Motor	1 Turbine (100%)/ 2 Motor (100% each)	1 Turbine (100%)/ 2 Motor (50% each)	1 Turbine (100%)/ 2 Motor (50% each)
Capacity	700GPM @ 2490 ft each	415GPM @ 2730 ft each	500GPM @ 1100psig	Turbine 600GPM @ 2437 ft Motor 300GPM @ 2437 each	Turbine 500GPM @ 1200psig Motor 250GPM @ 1200 psig each
Suction	CST'S (seismic), Demin Water Tanks, Pretreated Water Storage Tanks, Well Water System.	CST (seismic), Make-up Storage Tank, Make-up Demineralizer, Lake Michigan, Fire Protection System.	Demin. Water Storage Tank (seismic), Primary water storage tank.	CST, PWST, Fire Water Storage Tanks, City Water.	CST (Seismic)
Power	DG. for AC Valves	DG.	DG.	DG.	DG.
Initiation	Manual	Manual	Manual	Manual	Manual

*Turbine driven pump is not safety related.

TABLE 20 (Cont.)

	CALVERT CLIFFS 1 & 2	PALISADES	MAINE YANKEE	MILLSTONE #2	ST. LUCIE #1
SUPPORT SYSTEM	1) Salt Water System - Three pumps, 15,500PM @ 82 ft each. Cools service water & CCW heat exchangers & ECCS pump room coolers. DG. 2) Service Water - Three pumps and two heat exchangers. 7050GPM @ 180 ft each. This is a demineralized water system which cools the diesel generators. DG. 3) CCW - Cools ECCS pump seals & coolers & the shutdown heat exchangers. Three pumps & two heat exchangers. DG.	1) Service Water - Three 50% pumps, 8000 GPM @ 140 ft each. Cools the diesel generator & CCW heat exchangers. DG. This system's supply headers can be backed up by the plant fire water supply (2 diesel & 1 electrical pumps). 2) CCW - Three 50% capacity pumps rated 6000GPM @ 164 ft each. Two 50% heat exchangers. Cools shutdown heat exchangers, ECCS pumps & glands.	1) Service Water - Four 100% pumps rated 10,000 GPM @ 66 ft each. Cools CCW heat exchangers. (DG). 2) CCW - This system is split into two completely separate sub-systems, Primary & Secondary CCW. Each system has two 100% pumps & two 100% heat exchangers (D.G.). Pumps are rated 6000GPM @ 190 ft each. Cools shutdown heat exchangers, ECCS pumps & diesel generators	1) Service Water - Three 50% pumps rated 12000GPM @ 100 ft each. Cools RBCCW heat exchangers & diesel generators. (DG). 2) RBCCW - Three pumps rated 7000GPM @ 150 ft each & three heat exchangers. (DG). Cools ECCS pump seals & area coolers & shutdown heat exchangers.	1) Intake Cooling Water- Three pumps rated 14,500 GPM @ 130 ft each. (DG). Cools CCW heat exchangers 2) CCW - Two 100% systems Three pumps rated 8500GPM @ 180 ft each. Two heat exchangers. Cools shutdown heat exchangers & ECCS pumps.
DIESEL GENERATORS	2 per unit with an additional DG shared between units 1 & 2.	2 (100% each)	2	2	2 (Note: No external cooling water required)

TABLE 21

DHR SYSTEMS DATA FOR COMBUSTION ENGINEERING PLANTS IN GROUP #2

	ARK. NUCLEAR ONE #2	FORT CALHOUN 1	SAN ONOFRE 2
CORE MWT	2815	1420	3390
NO. LOOPS	2	2	2
CONTAINMENT TYPE	DRY	DRY	DRY
# SAFETY VALVES	2	2	2
# PORV'S	1 (Vent Valve)	2	NONE
HIGH PRESS. SAFETY INJ.			
# Pumps	3 (1/3 REQ'D)	3 (1/3 REQ'D)	3 (1/3 REQ'D)
Capacity	300GPM @ 2800 ft each	150GPM @ 2800 ft each	415GPM @ 2830 ft each
Suction	RWST with auto-transfer to Containment Sump	RWST with auto-transfer to Containment Sump	RWT with auto-transfer to Containment Sump
Power	DG	DG	DG
Support	Service Water - area and pump coolers	CCW - cools pump seals	CCW - cools motor and seals
CHARGING SYSTEM			
# Pumps	3	3	3
Capacity	44GPM @ 2300psig each	40GPM @ 2200psig each	44GPM @ 2300psig each
Suction	VCT, Primary Makeup Tank, Boric Acid Pumps	VCT, Boric Acid Pumps	VCT
Power	DG	DG	DG

TABLE 21 (CONT.)

	ARK. NUCLEAR ONE #2	FORT CALHOUN 1	SAN ONOFRE 2
LOW PRESS SAFETY INJ.			
# Pumps	2	2	2
Capacity	3250GPM @ 350 ft. each	1500GPM @ 400 ft each	4150GPM @ 342 ft each
Suction	RWST or Containment Sump (LPSI Pumps auto-stop on transfer from RWST to sump)	RWST or Containment Sump (LPSI pumps auto-trip on transfer from RWST to sump)	RWT or Containment Sump (LPSI pumps auto-trip on transfer from RWT to sump)
Power	DG	DG	DG
Support	Service Water - Cools area and pump seal coolers.	CCW - Cools pump seals	CCW - Cools pump seals and motor.
SHUTDOWN COOLING			
# Pumps	Uses LPSI pumps	Uses LPSI pumps	Uses LPSI pumps
# Heat Exchangers	2	2	2
Support	Service Water - Cools heat exchangers, pump cooler and area cooler	CCW - Cools pump seals and heat exchangers	CCW - Cools pump seals and motor and heat exchangers
AUX. FEEDWATER			
# Pumps	1 Turbine/1 motor (100% each)	1 Turbine/1 motor* (100% each)	1 Turbine/2 motor (100% each)
Capacity	575GPM @ 2800 ft each	260GPM @ 2400 ft each	860GPM @ 2842 ft each
Suction	Primary Condensate Tank, Swing Condensate Tank, Service Water (Seismic)	Emergency FW Storage Tank (Seismic)	CST (Seismic), condensate demineralizers, fire protection system, or Unit #3 Condensate System
Power	DG	DG	DG
Initiation	Automatic	Automatic	Automatic

*Motor driven pump breaker must be manually closed to place it on the Class IE bus.

TABLE 21 (CONT.)

	ARK. NUCLEAR ONE #2	FORT CALHOUN 1	SAN ONOFRE 2
SUPPORT SYSTEM	1) Service Water - Three 100% pumps rated 12000GPM @ 205 ft each (DG). Cools ECCS pumps and area coolers; shutdown heat exchangers and diesel generators.	1) Raw Water - Four pumps rated 5415GPM @ 118 ft each (DG). Cools CCW heat exchangers. 2) CCW - Three pumps rated at 3750 to 5400GPM @ 200 to 150 ft head each (D.G.). Has 4 heat exchangers. Cools shutdown heat exchangers, and ECCS pumps.	1) Salt Water Cooling - Has two 100% trains with 2 pumps per train. Each pump has 100% capacity and is rated 17,000GPM @ 80 ft. (DG). Cools CCW heat exchangers. 2) CCW - Two 100% loops. Each loop has 1 pump/1 heat exchanger with 3 pumps total. Rated 14,000GPM @ 140 ft each. Cools ECCS motors and shutdown heat exchangers.
DIESEL GENERATORS	2	2 (Note: No external cooling water required.)	2 (Note: No external cooling water required.)

TABLE 22

PRELIMINARY DHRS GROUPING
COMBUSTION ENGINEERING GROUP #1 SIMILAR TO CALVERT CLIFFS 1 & 2 (RSSMAP/IREP)

PLANT	POWER (MW)	LOOPS	CONTAINMENT	DHRS DIFFERENCES	COMMENTS
CALVERT CLIFFS 1&2	2700	2	DRY	REFERENCE PLANT	
PALISADES	2530	2	DRY	HAS 1 MOTOR/1 TURBINE DRIVEN AFW PUMPS INSTEAD OF 2 TURBINE DRIVEN PUMPS. THE TURBINE DRIVEN PUMP IS NOT SAFETY GRADE.	SEP PLANT
MAINE YANKEE	2630	3	DRY	HIGH PRESSURE SAFETY INJECTION (HPSI) AND CHARGING PUMPS ARE THE SAME PUMPS. HPSI PUMPS ARE CAPABLE OF DELIVERING FLOW AT PRESSURIZER PORV OR SAFETY VALVE SET POINTS. HAS 1 TURBINE/ 2 MOTOR DRIVEN AFW PUMPS INSTEAD OF 2 TURBINE DRIVEN PUMPS.	
MILLSTONE 2	2560	2	DRY	HAS 1 TURBINE/2 MOTOR DRIVEN AFW PUMPS INSTEAD OF 2 TURBINE DRIVEN PUMPS	
ST. LUCIE 1	2560	2	DRY	SAME AS ABOVE	DG'S DO NOT REQUIRE EXTERNAL COOLING WATER.

TABLE 23

PRELIMINARY DHRS GROUPING
COMBUSTION ENGINEERING GROUP #2 SIMILAR TO ARKANSAS NUCLEAR ONE - #2

PLANT	POWER (MW)	LOOPS	CONTAINMENT	DHRS DIFFERENCES	COMMENTS
ARKANSAS NUCLEAR ONE - #2	2815	2	DRY	REFERENCE PLANT	
FORT CALHOUN 1	1420	2	DRY	THE MOTOR DRIVEN AFW PUMP BREAKER MUST BE MANUALLY CLOSED TO PLACE MOTOR ON CLASS IE BUS.	DG'S DO NOT REQUIRE EXTERNAL COOLING.
SAN ONOFRE 2	3390	2	DRY	HAS 1 TURBINE/2 MOTOR DRIVEN AFW PUMPS INSTEAD OF 1 TURBINE AND 1 MOTOR DRIVEN PUMP. HAS NO PORV'S.	TO BE LICENSED IN 1982. DG's DO NOT REQUIRE EXTERNAL COOLING.

TABLE 24

DHR SYSTEMS DATA FOR BABCOCK AND WILCOX PLANTS

	ARKANSAS NUCLEAR 1	DAVIS BESSE 1	OCONEE 1,2 & 3	CRYSTAL RIVER 3
CORE MWT	2568	2772	2568	2452
NO. OF LOOPS	2	2 (raised loop design)	2	2
CONTAINMENT	Dry	Dry	Dry	Dry
# SAFETY VALVES	2	2	2	2
# RELIEF VALVES	1	1	1	1
HPSI				
No. of Pumps	3 (1/3 REQ'D)	2 (1/2 REQ'D)	3 (1/3 REQ'D)	3 (1/3 REQ'D)
Capacity	400 GPM @ 1600 psig each	200 GPM @ 1600 psig each (Note: Shutoff head of these pumps cannot lift the PORV's)	450 GPM @ 1700 psig each	400 GPM @ 1600 psig each
Suction	BWST or discharge of LPSI pumps	BWST or discharge of LPSI pumps	BWST or discharge of LPSI pumps	BWST or discharge of LPSI pumps
Power	DG	DG	DG	DG
Support	Service Water - Lube oil and room coolers	Service Water - Room cooler CCW - Cools pump seals	Low Pressure Service Water - Pump bearing and seal coolers	NSCCCW - 3/3 pump and motor coolers DHCCCW - 2/3 pump and motor coolers
MAKEUP/PURIF. SYSTEM	Uses HPSI pumps	Separate makeup pumps which can lift the PORV's	Uses HPSI pumps	Uses HPSI pumps
LPSI				
No. of Pumps	2	2	3	2
Capacity	3000 GPM @ 100 psig each	3000 GPM @ 350 ft. each	3000 GPM @ 100 psig each	3000 GPM @ 350 ft. each
Suction	BWST or reactor sump with manual switchover from injection to recirculation	BWST or reactor sump with manual switchover from injection to recirculation	BWST or reactor sump with manual switchover from injection to recirculation	BWST or reactor sump with manual switchover from injection to recirculation
Power	DG	DG	DG	DG
Support	Service Water - cools pump bearings	Service Water-room cooler CCW-cools pump seals	*	DHCCCW - Pumps and motor coolers

TABLE 24 (CONT.)

	ARKANSAS NUCLEAR 1	DAVIS BESSE 1	OCONEE 1,2 & 3	CRYSTAL RIVER 3
<u>DHR SYSTEM</u>				
# of Coolers	2	2	2	2
Support	Service Water - Cools the coolers <u>Note</u>: DHR uses LPSI pumps	CCW - Cools the coolers <u>Note</u>: DHR uses LPSI pumps	Low Pressure Service Water - Cools the coolers <u>Note</u>: DHR uses LPSI pumps	DHCCCW - Cools heat exchangers <u>Note</u>: DHR uses LPSI pumps
<u>EMERGENCY FEEDWATER</u>				
No. of Pumps	1 turbine/1 motor	2 turbine (100% each)	1 turbine/2 motor**	1 turbine/2 motor
Capacity	780 GPM @ 2600 ft. each	1050 GPM @ 1050 psig	turbine-1080GPM @ 1050 psig motor - 500 GPM each	740 GPM each
Suction	CST, Service Water (Seismic)	CST, DA Storage Tanks, Firewater, Service Water (Seismic)	Hotwell, upper surge tank	CST, hotwell, demineralized water from other units
Power	DG-motor pump; DC-turbine valves	Steam	DG-motor pump, turbine pump lube oil cooling. DC-lube oil pump	DG
Initiation	Automatic for turbine driven pump	Automatic	Automatic	Turbine - Automatic Motor - Manual
<u>SUPPORT SYSTEM</u>	1) Service Water-Three 100% pumps rated 6500 GPM @ 167 ft. each (D.G.) Cools D.G., DHR coolers, HPSI and LPSI pumps and room coolers.	1) Service Water-Three 100% pumps rated 10,250 GPM @ 160 ft. each (D.G.) Cools CCW heat exchangers, ECCS rooms. This is also an alternate source of water to EFW pumps. 2) CCW - 3 pumps and 3 heat exchangers, rated 7860 GPM @ 150 ft. each. Cools DHR coolers and D.G.'s.	1) Low Pressure Service Water - Two pumps rated 15,000 GPM each. Cools the decay heat coolers.	1) Nuclear Service Cooling Water - 2 emergency pumps rated 14,100 GPM @ 144 ft. each & one normal pump rated 10,800 GPM @ 98 ft. Cools NSCCCW heat exchangers. 2) Nuclear Service Closed Cycle Cooling Water (NSCCCW) - 2 emergency pumps rated 11,000GPM @ 190 ft. each and 1 normal pump rated 6900GPM @ 110 ft. 4 heat exchangers. 2 booster pumps rated 200GPM @ 215 ft. each. Cools HPSI pumps and motors and EFW lube oil coolers.

TABLE 24 (CONT.)

	ARKANSAS NUCLEAR 1	DAVIS BESSE 1	OCONEE 1,2 & 3	CRYSTAL RIVER 3
SUPPORT SYSTEM (Cont'd)				3) Decay Heat Service Water - 2 pumps rated 9700 GPM @ 75 ft. each. Cools DHCCCW heat exchangers. 4) Decay Heat Closed Cycle Cooling Water (DHCCCW) - 2 pumps and 2 heat exchangers. Rated 3200 GPM @ 80 ft. each. Cools DHC coolers, LPSI and HPSI pumps and motors.
DIESEL GENERATORS	2	2	Has no D.G.'s but 2 hydro-generators. One hydro-generator is good for all 3 units simultaneously.	2

*Information not currently available.

**The High Head Auxiliary Service Water, a safe shutdown system, is an alternate means of supplying water to the steam generators on loss of EFW. One pump (2250 GPM) with manual initiation, sufficient for all 3 units.

TABLE 24 (CONT.)

	TMI-1	RANCHO SECO
CORE MWT	2535	2772
NO. OF LOOPS	2	2
CONTAINMENT	Dry	Dry
# SAFETY VALVES	2	2
# RELIEF VALVES	1	1
HPSI		
No. of Pumps	3 (1/3 REQ'D)	3 (1/3 REQ'D)
Capacity	400 GPM @ 1600psig each	400 GPM @ 1600psig each
Suction	BWST or discharge of LPSI pumps	BWST or discharge of LPSI pumps
Power	DG	DG
Support	DHCCSW - 2/3 pump motors and bearings NSCCCW - 3/3 pump motors and bearings	*
MAKEUP/PURIF SYSTEM	Uses HPSI pumps	Uses HPSI pumps
LPSI		
No. of Pumps	2	2
Capacity	3000 GPM @ 100psig each	*
Suction	BWST or reactor sump with manual switchover from injection to recirculation	BWST or reactor sump with manual switchover from injection to recirculation
Power	DG	DG
Support	NSCCCW - room cooler	*
DHR SYSTEM		
# of Coolers	2	2
Support	DHCCSW-cools the coolers	*
	Note: DHR uses LPSI pumps	Note: DHR uses LPSI pumps

TABLE 24 (CONT.)

	TMI-1	RANCHO SECO
EMERGENCY FEEDWATER		
No. of Pumps	1 turbine/2 motor	1 tandem/1 motor
Capacity	Turbine - 920 GPM Motor - 460 GPM	840 GPM each
Suction	CST, Reactor Building Service Water	CST (seismic), canal, reservoir
Power	DG	DG
Initiation	*	Automatic
SUPPORT SYSTEMS	1) Decay Heat River Water - Two 100% pumps and heat exchangers rated 7900 GPM @ 68 ft. each. This cools the Decay Heat Closed Cycle Service Water System. 2) Decay Heat Closed Cycle Service Water - Two 100% pumps and heat exchangers rated 3900GPM @ 75 ft. each. Cools ECCS pumps and motors and decay heat coolers. 3) Nuclear Service River Water - Three 50% pumps and four 33-1/3% heat exchangers. Cools Nuclear Service Closed Cycle Cooling Water. 4) Nuclear Service Closed Cycle Cooling Water - Three 50% pumps and four heat exchangers. Cools ECCS pumps and motors and EFW pump rooms.	*
DIESEL GENERATORS	2	2

*Information not currently available.

TABLE 25

PRELIMINARY DHRS GROUPING
BABCOCK AND WILCOX PLANTS SIMILAR TO ARKANSAS NUCLEAR ONE-1

PLANT	POWER	LOOPS	CONTAINMENT	DHRS DIFFERENCES	COMMENTS
ARKANSAS NUCLEAR ONE-1	2568	2	DRY	REFERENCE PLANT	(IREP)
DAVIS BESSE	2772	2	DRY	HAS SEPARATE MAKEUP PUMPS. HAS 2 TURBINE DRIVEN INSTEAD OF 1 MOTOR AND 1 TURBINE DRIVEN EFW PUMP	RAISED LOOP. HPSI PUMPS CANNOT LIFT PORV'S
OCONEE 1,2&3	2568	2	DRY	HAS 3 LPSI PUMPS INSTEAD OF 2. HAS 1 TURBINE/2 MOTOR INSTEAD OF 1 MOTOR AND 1 TURBINE DRIVEN EFW PUMPS. HAS A HIGH HEAD AUXILIARY SERVICE WATER SYSTEM AS A BACKUP TO THE EFW SYSTEM BUT NO SAFETY GRADE SOURCE FOR EFW	HAS 2 HYDRO GENERATORS INSTEAD OF DIESEL GENERATOR (RSSMAP)
CRYSTAL RIVER 3	2452	2	DRY	HAS NO SAFETY GRADE SOURCE FOR EFW.	(IREP)
THREE MILE ISLAND 1	2535	2	DRY	HAS 2 HALF SIZED MOTOR DRIVEN EFW PUMPS. HAS NO SAFETY GRADE SOURCE FOR EFW.	
RANCHO SECO	2772	2	DRY	HAS 1 TURBINE-MOTOR TANDEM DESIGNED EFW PUMP INSTEAD OF A DIRECT DRIVE TURBINE PUMP	

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This grouping report provides a compilation of decay heat removal systems (DHRS) data for operating commercial light water reactors. The reactors have been divided into 12 groups based on similarity of the DHRS and related systems as part of the NRC Task Action Plan on Shutdown Decay Heat Removal Requirements.

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