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initiate the short-term injection and long-term injection systems manually, a low pressure signal must be present in the RPV, thus preventing inadvertent manual initiation of the system during normal reactor operation.

6.3.2.7 Gravity-Driven Cooling System

6.3.2.7.1 Design Bases

Safety Design Bases

The GDCS provides emergency core cooling after any event that threatens the reactor coolant inventory. Once the reactor has been depressurized the GDCS is capable of injecting large volumes of water into the depressurized reactor pressure vessel (RPV) to keep the core covered.

The system also drains the GDCS pools to the lower drywell in the event of a core melt sequence that causes failure of the lower vessel head and allows the molten fuel to reach the lower drywell cavity floor. This action is accomplished by detection of elevated temperatures registered by thermocouples penetrating the protective layer in the lower drywell cavity, and by logic circuits that actuate squib-type valves on independent pipelines draining GDCS pool water to the lower drywell region.

The GDCS requires no external AC electrical power source or operator intervention. The GDCS initiation signal is the receipt of a confirmed Level 1 signal from the NBS. This signal initiates ADS and ___-second timers as well as __-minute timers in the GDCS logic. After ___ seconds, squib valves are activated in each of the injection lines leading from the GDCS pools to the RPV, thus making GDCS flow possible. The actual GDCS flow delivered to the RPV is a function of the differential pressure between the reactor and the GDCS injection nozzles. The ___-second delay allows the RPV to be substantially depressurized prior to squib valve actuation. The GDCS flow per division is given in Figure 6.3-1. These flow rates assume that the GDCS pools are at minimum normal water level, and GDCS pool water temperature is at its maximum value shown in Table 6.3-3.

After a __ minute time delay and when the RPV coolant level decreases to __ m (___ ft.) above the top of the active fuel (TAF), squib valves are actuated in each of three GDCS equalizing lines. The open equalizing lines leading from the suppression pool to the RPV make long-term coolant makeup possible. The __-minute delay ensures that the GDCS pools have had time to drain to the RPV and that the initial RPV level collapse as a result of the blowdown does not open the equalizing line. The long-term flow requirements for the GDCS equalizing lines are as follows: with the suppression pool water at saturation temperature, with vessel water level below equalizing line nozzles, the flow delivered inside the RPV through the GDCS equalizing lines is as shown in Table 6.3-4. This flow is required assuming a double-ended-guillotine-break in one GDCS equalizing line, and the worst single failure in a second equalizing line.

In the event of a core melt accident in which molten fuel reaches the lower drywell, the flow through the deluge lines is required to flood the lower drywell region with a required deluge network flow rate as shown in Table 6.3-4. The system design is such that with a single failure the flood-line network drains at least two out of three GDCS pools into the lower drywell.

6.3.6.3 Limiting Break Results

For the initial core, the results for the limiting break for each bundle design will be provided to the USNRC by the COL applicant.

6.3.7 References

{Reference 6.3-1 may be outdated, and thus, must be updated. Ref. 6.3-2 is used appropriately}

6.3-1 GE Nuclear Energy, “Depressurization Valve Development Test Program Final Report,” GEFR-00879, October 1990.

6.3-2 General Electric Co., “General Electric Company Analytical Model for Loss-of Coolant Analysis in Accordance with 10 CFR 50, Appendix K,” NEDE-20566P-A, September 1986.

Table 6.3-4

GDCS Design Basis Parameters

Parameter	Value As Assumed/Modeled In ECCS Performance Evaluation
Number of separate/independent GDCS divisions	4
Per division, number of (short-term core cooling) lines from its GDCS pool	1
Per division, number of GDCS line RPV nozzles	2
Per division, number of equalizing line RPV nozzles	1
Minimum drainable inventory per GDCS pool	___ m^3 (___ ft^3)
Minimum elevation of GDCS pool surfaces above the RPV nozzles	___ m (___ ft)
Minimum short-term core cooling flow vs. ΔP	Figure 6.3-1
Minimum long-term core cooling flow delivered by the GDCS equalizing lines for a ΔP of ___ kPa (0._ psid) across the equalizing lines	_____ m^3/s (___ gpm)
Minimum flow through the deluge lines required to flood the lower drywell region	_____ m^3/s (___ gpm) *
Minimum available suppression pool water inventory 1 meter above TAF	___ m^3 (___ ft^3)
Minimum GDCS equalizing line driving head	___ m (___ ft)
{Others, as applicable, to be supplied by ESBWR Project}	

* Core melt scenario instead of ECCS performance evaluation scenarios.

{ESBWR Project to provide.}

Figure 6.3-3. GDCS Squib Valve — Closed