SAFETY ANALYSIS

14.0 SAFETY ANALYSIS [UNIT 2]

This chapter presents an evaluation of the safety aspects of Unit 2 of Cook Nuclear Plant and demonstrates that Unit 2 can be operated safely even if highly unlikely occurrences are postulated. It also shows that radiation exposures to the public and control room as a result of these highly unlikely occurrences do not exceed the limits of Regulatory Guide 1.183 and 10 CFR 50.67.

Unit 2 of Cook Nuclear Plant was initially loaded with fuel fabricated by Westinghouse Electric Corporation for the first three cycles. From Cycle 4 through Cycle 7, reload fresh fuel was fabricated by Siemens Power Corporation previously known as Advanced Nuclear Fuel and Exxon Nuclear Company. Starting with Cycle 8, the fabrication of fresh reload fuel is again furnished by Westinghouse, this time using the 17 x 17 Vantage 5 fuel assembly design. The transition to a reactor core completely composed of Westinghouse vantage 5 fuel assemblies was completed at the beginning of Cycle 10 (i.e., the 1994 refueling outage). To the extent that the safety analyses in this chapter involve a particular fuel design, it is the Westinghouse Vantage 5 fuel that is considered.

This chapter is divided into the three sections described below, each section dealing with a different (licensing basis) category of fault conditions.* The ANS Conditions II, III, and IV are based on the anticipated frequency of their occurrence and are related to the licensing basis categories as described below. There are four ANS fault conditions: Condition I, Condition II, Condition III and Condition IV. ANS Condition I occurrences do not require a safety analysis because they represent normal operational transients.

ANS Condition II occurrences are faults that may occur with moderate frequency during the life of the plant. They are accommodated with, at most, a reactor shutdown with the plant being capable of returning to operation after a corrective action. In addition, no ANS Condition II occurrence shall cause consequential loss of function of fuel cladding and reactor coolant system barriers.

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* The three categories of fault conditions analyzed in this chapter do not have a one to one correspondence with the ANS Conditions II, III, and IV, but each fault condition in each category is also identified as either ANS Condition II, III or IV.

ANS Condition III occurrences are faults that may occur very infrequently during the life of the plant. They may be accompanied by the failure of only a small fraction of the fuel rods although sufficient fuel damage might occur to preclude resumption of the operation for a considerable outage time. The release of radioactivity will not be sufficient to interrupt or restrict public use of those areas beyond the exclusion radius. An ANS Condition III occurrence will not, by itself, generate an ANS Condition IV fault or result in a consequential loss of function of the reactor coolant system or containment barriers.

ANS Condition IV occurrences are faults that are not expected to take place, but are postulated because their consequences would include the potential for the release of significant amounts of radioactive material. These are the most drastic occurrences that must be designed against and represent limiting design cases. ANS Condition IV occurrences shall not cause a fission product release to the environment resulting in radiation exposures to the public and control room in excess of the limits of Regulatory Guide 1.183 and 10 CFR 50.67. A single ANS Condition IV occurrence shall not cause a consequential loss of required functions of systems needed to cope with the fault including those of the emergency core cooling system (ECCS) and the containment.

Core and Coolant Boundary Protection Analysis, Section 14.1

The majority of the fault conditions discussed in this section are ANS Condition II occurrences. Section 14.1 also includes an ANS Condition III occurrence, complete loss of forced reactor coolant (Section 14.1.6.1), and an ANS Condition IV occurrence, locked rotor (Section 14.1.6.2).

Standby Safeguards Analysis, Section 14.2

The fault conditions listed in this section are very infrequent and may lead to a breach of fission product barriers. Section 14.2 includes events other than ANS Condition III occurrences, such as rupture of a control rod drive mechanism housing (Section 14.2.6), major rupture of a main feedwater pipe (Section 14.2.8), and rupture of a steam line (Section 14.2.5), which are ANS Condition IV occurrences.

Reactor Coolant System Pipe Rupture (Loss of Coolant Accident or LOCA), Section 14.3

The occurrence discussed in this section is a rupture of a reactor coolant pipe up to and including the double-ended severance of the largest pipe in the reactor coolant system (large break LOCA or LBLOCA), which is the worst conceivable and therefore is used as a basis for the design of engineered safeguards. Section 14.3 includes small break LOCA (SBLOCA) (Section 14.3.2), which is an ANS Condition III occurrence.

Changes from Base Accident Analyses: Note Concerning Tables and Figures

If an evaluation is needed for some change from a base accident analysis of record, and the evaluation changes information appearing in the UFSAR, a text description of the evaluation is provided in the appropriate text section of Chapter 14. However, unless specifically indicated otherwise, the associated tables and figures for the accident analysis are taken from the base accident analysis of record, and not any subsequent specific evaluation.

14.0.1 Summary of Results

To support the Cook Nuclear Plant Unit 2 with 17 x 17 VANTAGE 5 fuel, safety analyses and evaluations are performed as appropriate. Table 14.0-1 presents the list of non-LOCA and LOCA occurrences analyzed or evaluated for the VANTAGE 5 fuel. The only non-LOCA occurrence that was not analyzed for the VANTAGE 5 fuel is the startup of an inactive loop event. This occurrence was not analyzed since it cannot occur above the P-7 permissive setpoint (11% power) as restricted by the operating license. The safety analysis presented in FSAR Section 14.1.7 remains bounding with respect to the restriction to 11% power for the operation of three reactor coolant pumps imposed by the operating license. The results of the safety analyses and evaluations presented in the following sections show that operating with 17x17 VANTAGE 5 fuel, Cook Nuclear Plant Unit 2 can satisfy the applicable FSAR safety limits.

For a full Westinghouse 17 x 17 VANTAGE 5 core, the non-LOCA safety analyses and evaluations support plant operation with an uprated core power of 3588 Mwt in the range of RCS average temperatures between 547°F and 581.3°F at RCS pressure of 2100 psia or 2250 psia. The LBLOCA analyses support plant operation at 3468 MWt plus 0.34% uncertainty The long-term containment pressure analyses support plant operation at 3411 MWt plus 2% uncertainty. The SBLOCA analysis with the high head SI cross-tie valves open supports operation up to a core power of 3600 MWt (plus 0.34% uncertainty).

Cook Unit 2 has been assessed for impact to support a Measurement Uncertainty Recapture (MUR) power uprate to allow the licensed core rated thermal power to increase from 3411 MWt to 3468 MWt. The MUR power uprate strategy is to use reduced calorimetric error allowance to support an increase in the licensed core rated thermal power. The sum of the change in rated thermal power defined in the Technical Specifications and the MUR reduced calorimetric error allowance is equal to, or less than, the original +2% value supported by the safety analyses. The analyses performed using a core thermal power of 3588 MWt (plus 2% uncertainty) bounds the MUR uprated power level of 3468 MWt with the reduced uncertainty.

The non-LOCA safety analyses for Cook Unit 2 were evaluated for continued applicability considering the effects of an upflow conversion (UFC). The flow direction in the barrel-baffle region of the reactor vessel is not explicitly modeled in the non-LOCA analyses, and thus there is no direct impact from this change. However, a UFC can potentially affect the non-LOCA analyses by affecting the design parameters, most notably the core bypass flow. The evaluation concluded that the effects of the UFC are acceptable with respect to the non-LOCA safety analyses and the conclusions of the UFSAR remain valid.

OCCURRENCES EVALUATED FOR VANTAGE 5 FUEL

Fault Conditions Evaluated FSAR Section	Accident
14.1.7	Startup of an Inactive Reactor Coolant Loop
Fault Conditions Analyzed FSAR Section	**Accident**
14.1.1	Uncontrolled Rod Cluster Control Assembly Bank Withdrawal From a Subcritical Condition
14.1.2	Uncontrolled Rod Cluster Control Assembly Bank Withdrawal at Power
14.1.3	Rod Cluster Control Assembly Misalignment
14.1.4	Rod Cluster Control Assembly Drop
14.1.5	Uncontrolled Boron Dilution
14.1.6	Loss of Reactor Coolant Flow (including Locked Rotor Analysis)[1]
14.1.8	Loss of External Electric Load or Turbine Trip(1) , [2] ,
14.1.9	Loss of Normal Feedwater[3] ,[4]
14.1.10	Excessive Heat Removal due to Feedwater System Malfunctions
14.1.11	Escessive Load Increase Incident
14.1.12	Loss of Offsite Power to the Station Auxiliaries (3) , (4)
14.2.4	Steam Generator Tube Rupture
14.2.5	Rupture of a Steam Line
14.2.6	Rupture of a Control Rod Drive Mechanism Housing (RCCA Ejection)
14.2.8	Major Rupture of a Main Feedwater Pipe (3) , (4)
14.3.1	Major Reactor Coolant Pipe Ruptures
14.3.2	Loss of Reactor Coolant From Small Ruptured Pipes From Cracks in Large Pipes which Actuates the Emergency Core Coolant System

[1] Reanalyzed to support PSV setpoint tolerance of $\pm$3%.
[2] Reanalyzed to support MSSV setpoint tolerance of $\pm$3%.
[3] Evaluated to support MSSV setpoint tolerance of $\pm$3%.
[4] Evaluated to support PSV setpoint tolerance of $\pm$3%.