SUPPLEMENTAL SAFETY EVALUATION REPORT
BYRON STATION, UNIT 1
AUXILIARY SYSTEMS BRANCH

Introduction

NRC inspections of the Byron, Unit 1 plant identified several concerns regarding compliance with the fire protection and post-fire safe shutdown criteria. In response to the fire protection inspections, the applicant by letter dated June 28, 1984 provided Amendment 3 to the Byron/Braidwood Fire Protection Report. Amendment 3 included a revised safe shutdown analysis which reflects as-built conditions for the Byron, Unit 1 plant. Additional information regarding Byron's safe shutdown capability was provided by letters dated July, 1984 which provided Amendment 4 to the Fire Protection Report; August 2, 1984; August 20, 1984; October 11, 1984; and October 15, 1984. The following evaluation covers the post-fire safe shutdown capability for Byron, Unit 1. Other units of the Byron/Braidwood Stations will be addressed in separate safety evaluation reports.

Safe Shutdown Capability

By Amendment 3 to the Byron/Braidwood Fire Protection Report, the applicant revised the list of equipment necessary for post-fire safe shutdown of Byron, Unit 1. For hot standby, at least one train of the following systems would be available: (1) the charging system utilizing the refueling water storage tank; (2) the auxiliary feedwater system including the condensate storage tank, the steam generator safety valves, and the steam generator atmospheric relief valves; (3) the emergency diesel generators and essential switchgear; (4) the essential service water system including cooling tower fans; (5) instrumentation including pressurizer pressure and level, reactor coolant temperatures, and steam generator pressure and level indications; and (6) various support components including essential ventilation components. These systems in conjunction with at least one train of the following systems would be utilized for plant cooldown to cold shutdown: (1) the residual heat removal system and (2) the component cooling water system.

The applicant performed a cable separation study as part of the safe shutdown analysis to ensure the post-fire availability of at least one train of the above identified systems. Power, control and instrumentation cables were identified for the post-fire shutdown systems. The computerized cable tray data base for all cables of the Byron plant was utilized to correlate fire zones and cable routing. For each fire zone, a list of safe shutdown cables was generated. Conduit routings were manually added to the fire zone list.

For fire zones containing redundant equipment or cabling, the applicant verified that adequate fire protection measures, adequate repair capability, or alternative shutdown capability existed. Repair activities consist of installation of temporary cables for various components of the residual heat removal system. No repairs are needed for components to achieve post-fire hot standby conditions. All repair material is stored onsite, and procedures are in place to affect necessary repairs.

Alternative shutdown capability in part, consists of local operation of equipment if the fire results in loss of redundant control capability. Local operations include local start and control of pumps and manual operation of valves and circuit breakers. For all local operation, accessibility of components and time restrictions were considered. These local operations are addressed in various plant procedures. Alternative shutdown capability also consists of utilization of diverse equipment as follows. To monitor reactor coolant hot leg temperature, the applicant ensured the availability of one of the following components, all of which provide an indication of hot leg temperature: reactor coolant wide range hot leg RTD's, core exit thermocouples, or heated junction thermocouples. Alternative shutdown capability also includes use of remote shutdown and instrument panels as discussed below.

The applicant also considered associated circuits by verifying that fire-induced failures in cabling for equipment not required for achieving safe shutdown would not adversely impact safe shutdown. The applicant verified that adequate coordinated circuit protection exists to ensure availability of power supplies necessary for post-fire safe shutdown. Further, the

electrical design of the plant ensures that associated cables of redundant divisions do not share common enclosures (cable tray, conduit or raceway).

The applicant also performed a detailed analysis of circuits whose fire-induced spurious operation could adversely impact safe shutdown. This analysis included a review of high-low pressure interfaces. For each fire zone, the applicant's analysis assumed all equipment and circuits located in the fire zone were unavailable and one spurious actuation resulted from the fire. The applicant's analysis demonstrated that through the fail-safe design of air-operated valves or with manual operation of components, post-fire safe shutdown would not be adversely impacted. For the high-low pressure interface of the RHR pump suction lines, the applicant demonstrated that adequate separation of the valve control circuits and pressure interlock circuits existed to ensure one valve of the redundant valves in series would not spuriously operate due to fire-damage in any one fire area. For our concern of spurious operation of the pressurizer PORV's, the applicant has committed to prevent or mitigate the spurious operation of these valves by either 1) isolating the valves prior to an occurrence of a fire, 2) providing electrical isolation, or 3) providing a means to detect and defeat any spurious operations.

Based on the above, the staff concludes that the post-fire safe shutdown capability for Byron, Unit 1 complies with the guidelines of SRP Section 9.5.1, Position C.5.b pending the following condition: "The applicant shall complete the analysis of spurious operation of the pressurizer PORV's and fully implement any necessary modifications prior to exceeding 5% power."

Alternative Shutdown Capability

Section 7.4.1 of the Final Safety Analysis Report (FSAR) describes the remote shutdown panels' design and capability. The design objective of the remote shutdown panels is to provide a central point to control and monitor plant shutdown independent of the control room in the event of an evacuation of the

control room. The design of the panels includes the capability to electrically isolate the instrumentation indications and control functions for the shutdown systems from the control room. The auxiliary feedwater system, main steam atmospheric relief valves, and chemical and volume control system (charging pump and letdown line) can be manually controlled from the panels to achieve and maintain hot shutdown independent of the control room. Initiation of the residual heat removal system for achieving cold shutdown is performed at local locations. Support system functions are initiated either at the remote shutdown panels or at local locations.

The design of the remote shutdown system was reviewed to determine compliance with the criteria of SRP Section 9.5.1, Position C.5.c. Reactivity control is accomplished by a manual scram before the operator leaves the control room and boron addition via the chemical and volume control system (charging pumps) utilizing the refueling water storage tank. Reactor coolant makeup is also provided by the charging portion of the chemical and volume control system. Reactor decay heat removal in hot shutdown is provided through the steam generator by the auxiliary feedwater system and main steam atmospheric relief valves, and in cold shutdown by the residual heat removal system, component cooling water system, and essential service water system. Cold shutdown can be achieved within 72 hours following a fire in any plant area.

In addition, the applicant has committed to install a "Fire Hazards Panel". The "Fire Hazards Panel" will contain indication for two channels each of steam generator level and pressure, one channel each of pressurizer pressure and level, four channels each of reactor coolant hot and cold temperature, and one channel at source range neutron flux. The instrumentation and cabling for the "Fire Hazards Panel" will be independent (physically and electrically) of the control room and auxiliary electric equipment room. The design of the panel will utilize replacement of existing reactor coolant hot and cold temperature elements with duel element models. The cables associated with the second element will be routed such that a fire could not disable all temperature indication.

The applicant has committed to install the panel and associated modifications at the first outage projected to be of two weeks or greater duration after achieving 50% power. If no such outage occurs, the panel and modifications will be completed prior to startup from the first refueling outage. In the interim, the applicant will institute a fire watch in the auxiliary electrical equipment room. A continuous fire watch will be used any time the plant is operating above 5% power in Mode 1. A roving fire watch (hourly) will be used at all other times.

Based on the above, the staff concludes that the alternative shutdown capability complies with the guidelines of SRP Section 9.5.1, Position C.5.c and is, therefore, acceptable pending the following condition:

> The applicant shall provide the "fire hazards panel" and associated instrumentation modifications at the first identified outage projected to be of two weeks or greater duration after achieving 50% power. If no such outage occurs, the applicant shall provide the panel and associated modifications by startup from the first refueling outage but in no case later than September 30, 1986.

Deviation Requests

In Amendment 3, the applicant requested a deviation (No. C.1) from the criteria of SRP Section 9.5.1 regarding separation of redundant pressurizer PORV and block valve cables. The applicant indicated that loss of control capability for these valves would not adversely impact safe shutdown. For hot standby, pressurizer overpressure protection would be provided by the pressurizer safety valves. For cold shutdown, primary cooldown and depressurization would be achieved by utilizing the steam generators to remove decay heat in conjunction with the letdown system. Sufficient cooldown and depressurization can be accomplished to allow initiation of the residual heat removal system. Spurious operation of the pressurizer PORV is addressed in the safe shutdown portion of this SER. Based on the above, the staff concludes that the applicant's proposed shutdown capability is acceptable.

In Amendment 3, the applicant requested deviation (No. C.6) from the criteria of SRP Section 9.5.1 regarding separation of redundant reactor coolant cold leg temperature instrumentation. The applicant has committed to modify the cold leg temperature detectors with duel element models. The second element will be separated from the redundant component in accordance with the criteria of SRP Section 9.5.1. In the interim, the applicant will utilize steam generator pressure to infer cold leg temperature. In addition, at least one channel of each of the following instruments will be available: reactor coolant hot leg temperature, steam generator pressure and level, and pressurizer pressure and level. Based on the above, the staff concludes that the applicant's interim measures are acceptable.

In Amendment 3, the applicant requested a deviation (No. C.7) from the criteria of SRP Section 9.5.1 regarding separation of redundant reactor coolant hot leg temperature instrumentation. The applicant has committed to modify the hot leg temperature detectors with duel element models. The second element will be separated from the redundant component in accordance with the criteria of SRP Section 9.5.1. In the interim, the applicant will utilize incore thermocouples to infer hot leg temperature. In addition, at least one channel of each of the following instruments will be available: reactor coolant cold leg temperature, steam generator pressure and level, and pressurizer pressure and level. Based on the above, the staff concludes that the applicant's interim measures are acceptable.