Program for Station Blackout (TAP A-44)

I. Description of Problem

The purpose of this task action plan is to determine if changes in licensing criteria are needed to protect nuclear power plants against a station blackout. In its simplest terms, a station blackout is defined as a loss of offsite and onsite (emergency) A.C. power to essential systems. The concern is that the occurrence of a station blackout may be a relatively high probability event and that the consequences of this event may be unacceptable, e.g., severe core damage.

It is required by NRC safety criteria that electric power for safety systems at nuclear power plants be supplied by at least two redundant and independent divisions. Each electrical division for safety systems includes an offsite A.C. power connection, an onsite standby emergency A.C. power supply (usually diesel generators), and D.C. power sources. The systems used to remove decay heat from the reactor core following a reactor shutdown are included among the safety systems that must meet these electrical power supply requirements. In addition, current NRC safety criteria require that diverse power drives be provided for redundant auxiliary feedwater pumps in PWRs. The design practice for BWRs is to include at least one decay heat removal system (RCIC) driven by a source independent of A.C. power.

90008002

(+ distr)

The loss of all A.C. power at a nuclear power plant is dependent on the reliability of the offsite power source and the reliability of the onsite emergency source. Loss of offsite power have occurred at several commercial nuclear plants and can be expected to occur in the future. During these loss of offsite power events there has not been a case in which at least one

8001110110

of the onsite emergency power supplies was not available. However, historical diesel generator reliability and the potential for common cause failure of the diesel generators is such that a station blackout may have a relatively high probability of occurrence for some plants. In this event, the ability to cool the reactor core would be dependent on the availability of systems not dependent on A.C. power, and on the ability to restore A.C. power in a timely manner. A station blackout followed by additional equipment failures, incorrect or delayed operator actions, or other unexpected events could result in an inability to cool the core with potentially serious consequences.

II. Plan for Problem Resolution

The program to resolve this issue will involve a reliability based assessment of A.C. power supplies for systems essential to assure shutdown cooling capability. Quantitative probabilistic methodology will be supplemented with reactor coolant system response analyses where it is needed to assess the system requirements for both performance and time of operation. Through the analysis of several ~~carefully selected~~ plant designs and design variations this program will evaluate the probability and duration of a station blackout followed by an evaluation of the consequences (in terms of core cooling capability) and the overall probability of losing decay heat removal capability from a station blackout.

Various failure modes

The program to resolve this issue will revolve around the following four main tasks:

add pri sys integrity containment integrity

90008003

POOR ORIGINAL

A. Probabilistic Assessment of Station Blackout as an Unresolved Safety Issue

1. Scope issue to provide more definitive technical assessment of the issue.

   a. Define the conditions which constitute a station blackout.

   b. Provide a preliminary estimate of station blackout probability.

   c. Preliminary identification of systems required during a blackout.

   d. Determine if partial A.C. power loss should be included.

   e. Identify generic and plant specific designs which will be analyzed using probabilistic risk techniques. only?

   f. Identify generic and plant-specific reactor coolant system response characteristics which require deterministic analyses.

Modes of failure

Partial failure of AC degradations

add Error & Precision Estimates

2. Identify initiating events.

   a. Identify the initiating events which can lead to a station blackout.

   b. Estimate the probability or frequency of occurrence of these events.

Modes

3. Probability of loss of A.C. power. 90008004

   a. Estimate the probability of loss of offsite power from data and electrical systems reliability analyses, as required.

Site and other Variability

Modes

b. Estimate the probability of loss of emergency onsite A.C. power to essential systems. Design & other Variability

c. Estimate the restoration time probabilities for offsite and onsite A.C. power to essential systems.

Site & other Variability

B. <u>Evaluation of Consequences of a Station Blackout</u>

1. Reliability of essential systems/components.

   a. Identify essential systems/components required during a station blackout using event/fault tree methodology. ?

   b. Identify important human/machine interfaces for station blackout.

   c. Estimate reliability of essential systems/components considering human/machine interfaces for station blackout.

CMF?

Design Variability? other?

2. Group sequences and perform reactor coolant system response analyses to assess time dependence and nature of consequences — damage to or melting of the core.

C. <u>Accident Recovery and Prevention</u> necessary? Safety Goals

1. Evaluate features to reduce probability and consequences.

   a. Identify and evaluate features to reduce probability of occurrence of station blackout.

   b. Identify and evaluate features to reduce the consequences in terms of damage to the core from a station blackout.

90008005

2. Evaluate potential for recovery.

   a. Identify human actions, systems and components which are required to restore offsite and onsite power.

   b. Identify human actions, systems and components which are required to cope with a station blackout, i.e., preclude unacceptable core damage or recover following core damage.

D. Reevaluation of Current Licensing Criteria Related to Station Blackout

1. Establish ~~acceptance~~ decision criteria. only criterion?

   a. Identify event/sequence probability below which no action is needed.

   b. Identify consequences (core damage) below which no action is needed.

2. Evaluate and revise, as necessary, current licensing design requirements.

   a. Assess current licensing criteria with regard to probabilistic/consequence criteria.

   b. Revise, as necessary, current licensing design criteria.