

PLANT RISK STATUS INFORMATION MANAGEMENT SYSTEM*

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ABSTRACT

The Plant Risk Status Information Management System (PRISIMS) is a PC program that presents information about a nuclear power plant's design, its operation, its technical specifications, and the results of the plant's probabilistic risk assessment (PRA) in a logically and easily accessible format. PRISIMS provides its user with unique information for integrating safety concerns into day-to-day operational decisions and/or long-range management planning.

PRISIMS was developed for NRC inspection personnel to help them allocate their efforts to actions that have the greatest potential for reducing plant risk. To address these specific users, one section of PRISIMS is based on decision matrices that relate plant information to inspection procedures (modules). The program lists decisions an inspector must make when implementing inspection modules, it shows how specific PRA results are helpful in making these decisions, and it guides the inspector to the appropriate PRA results.

The type of information contained in PRISIMS, the presentation format, and the rapid accessibility make PRISIMS useful for other regulatory personnel and nuclear utility personnel. The program can be tailored for any user with relatively minor modifications. And the user does not have to be a PRA expert to incorporate PRA-based information into his decision making. The PRA results and related information presented in PRISIMS are summarized according to the needs of the user and are presented in an easily understandable manner without using a lot of PRA jargon.

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MASTER

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PRISIMS operates in two modes: (1) a data base management mode and (2) an interactive mode. The data base manager is a sophisticated package that accesses and displays pre-programmed screen images. The screen images display relevant information in high- or low-resolution graphics or text modes. The screens are menus that allow the user to select paths to obtain more and more detailed information to support decisions of interest.

The interactive mode allows the user to input the current plant status to a risk model within the program to determine the safety impact of the plant state and the impacts of various contemplated actions. Inputting plant status consists of identifying components that are known to be out-of-service. The risk model calculates the instantaneous increase in plant risk associated with the specified plant state. The model also identifies the components or systems that are most critical to plant safety at the time.

The figures on the following pages are plots of screen images from PRISIMS. Each figure displays the position of the cursor that would take the user from that screen to the screen presented in the next figure. The series of figures demonstrates use of PRISIMS in the data base management mode.

These figures demonstrate how a user might query PRISIMS if the pump in the "C" train of the high pressure injection system (HPIS) were known to be out of service. The first five screens allow the user to quickly select the part of the program dedicated to information that is relevant when pump P36C is out of service. Paging through these first five screens would require less than a minute for an experienced user.

When pump P36C is out of service, there are single component failures that can cause failure of the HPIS. Some of these are covered by the plant's technical specifications and others are not. In this demonstration, the user is interested in those that are not covered (Figure 6). They are listed on the screen in Figure 7, and more detail about one of the component failures is presented in Figure 8.

In Figures 9 and 10, the user is paging back using the last branch point (LAST BP) option to pursue a different set of information of interest when P36C is out of service. Figure 11 shows the other components that are realigned to remove P36C from service and restore it to service.

The user then exits the program (Figure 12).

The first version of PRISIMS will be completed this December. Next year, NRC inspection personnel will test it in the field. It will be modified based on their suggestions and will serve as a prototype for versions for other nuclear power plants.

CONTINUE
QUIT

PLANT RISK STATUS INFORMATION MANAGEMENT SYSTEM

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Figure 1

MASTER MENU

ESCAPE

WOULD YOU LIKE TO SEE . . .

2
3

1. A LISTING OF THE PRA-BASED INFORMATION AVAILABLE IN THIS PROGRAM?
2. A LISTING OF THE RESIDENT MODULES ADDRESSED IN THIS PROGRAM?
3. A LISTING OF THE REGIONAL MODULES ADDRESSED IN THIS PROGRAM?

Figure 2

PRA-BASED INFORMATION AVAILABLE IN THIS PROGRAM

1. DOMINANT CONTRIBUTORS TO PLANT RISK
2. RISK IMPACTS OF VARIOUS OUT-OF-SERVICE SYSTEMS/COMPONENTS
3. RISK IMPACTS OF SELECTED HUMAN ERRORS
4. RANKINGS OF SYSTEMS/SUBSYSTEMS/COMPONENTS/HUMAN ERRORS ACCORDING TO THEIR CONTRIBUTIONS TO PLANT RISK
5. OVERALL RISK SIGNIFICANCE OF SYSTEMS/SUBSYSTEMS/COMPONENTS/HUMAN ERRORS
6. SINGLE FAILURES THAT CAN CAUSE A SYSTEM TO FAIL WHEN A GIVEN COMPONENT IS OUT OF SERVICE
7. LISTING OF PLANT LERS GROUPED BY COMPONENT TYPE

MASTER
ESCAPE
LAST BP
PREVIOUS
CONTINUE
1
2
3
4
5
6
7

(CONTINUED)

Figure 3

RISK IMPACT OF A SYSTEM THAT IS OUT OF SERVICE

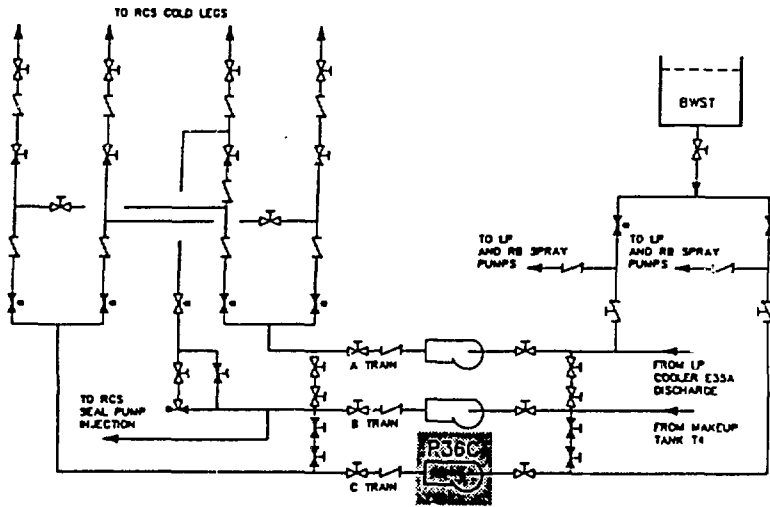
<u>SYSTEM</u>	<u>FACTOR BY WHICH CORE MELT FREQUENCY INCREASES</u>	MASTER ESCAPE LAST BP PREVIOUS
1. EMERGENCY DC POWER	21,000	1
2. REACTOR PROTECTION	2,100	2
3. EMERGENCY AC POWER	280	3
4. SERVICE WATER	78	4
5. EMERGENCY FEEDWATER	68	5
6. EMERGENCY FEEDWATER INITIATION CONTROL	68	6
7. BATTERY AND SWITCHGEAR EMERGENCY COOLING	62	7
8. SAFETY RELIEF	58	8
9. HIGH PRESSURE INJECTION	58	9
10. ENGINEERED SAFEGUARDS ACTUATION	4.2	10
11. LOW PRESSURE RECIRCULATION	4.1	11
12. HIGH PRESSURE RECIRCULATION	3.5	12
13. LOW PRESSURE INJECTION	1.6	13
14. POWER CONVERSION	1.4	14
15. CORE FLOOD	1.2	15

** TO SEE THE RISK IMPACT OF A COMPONENT FAILURE,
SELECT THE SYSTEM CONTAINING THE COMPONENT **

Figure 4

HIGH PRESSURE INJECTION SYSTEM SCHEMATIC

MASTER
ESCAPE
LAST BP
PREVIOUS



•• SELECT COMPONENT OF INTEREST USING CURSOR ••

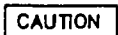
Figure 5

HPI PUMP P36C IS OUT OF SERVICE

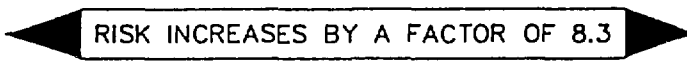
MASTER
ESCAPE
LAST BP
PREVIOUS
WARNING
CAUTION



SINGLE FAILURES THAT ARE NOT COVERED BY TECH SPECS EXIST WITHIN THE HPIS SUPPORT SYSTEMS AND CAN CAUSE THE HPIS TO FAIL.



SINGLE FAILURES THAT ARE COVERED BY TECH SPECS ALSO EXIST WITHIN THE HPIS AND ITS SUPPORT SYSTEMS AND CAN CAUSE THE HPIS TO FAIL.



- 1
- 2
- 3
- 4

1. HOW DOES THE RISK INCREASE FOR PUMP P36C COMPARE TO THE RISK INCREASES FOR OTHER COMPONENTS IN THE HPIS?
2. WHAT ARE THE HISTORICAL CAUSES OF FAILURE FOR P36C AND SIMILAR PUMPS?
3. WHAT OTHER COMPONENTS ARE REALIGNED TO REMOVE PUMP P36C FROM SERVICE AND/OR RESTORE IT TO SERVICE?
4. WHAT ARE THE TECH SPECS CONCERNING PUMP P36C?

Figure 6

SINGLE FAILURES THAT ARE NOT COVERED
BY TECH SPECS WHEN PUMP P36C IS OUT OF SERVICE

FAILURE OF ANY OF THESE COMPONENTS IN COMBINATION
WITH THE FAILURE OF PUMP P36C CAUSES THE FAILURE OF THE HPIS

1. CONTROL VALVE CV6036
[3-WAY VALVE IN THE EMERGENCY SWITCHGEAR ROOM COOLING SYSTEM]
2. CONTROL VALVE CV3808
[SERVICE WATER VALVE UPSTREAM OF HPI PUMP P36A LUBE OIL COOLER]
3. FAN VUC7A
[MAKEUP PUMP ROOM 54 COOLING FAN]
4. CIRCUIT BREAKER CB5214
[CIRCUIT BREAKER FOR CONTROL POWER TO CONTROL VALVE CV3808]
5. CIRCUIT BREAKER CB5216
[CIRCUIT BREAKER FOR CONTROL POWER TO MAKEUP PUMP
ROOM COOLER VUCM-7A]

.. TO SEE PERTINENT INFORMATION ABOUT VERIFYING THE OPERABILITY
OF ANY COMPONENT ABOVE, MOVE THE CURSOR TO THE COMPONENT NUMBER
AND PRESS RETURN ..

MASTER
ESCAPE
LAST BP
PREVIOUS
~~1~~
2
3
4
5

Figure 7

CONTROL VALVE CV6036

IN THE EVENT OF AN ACCIDENT, IF CONTROL VALVE CV6036 IS OUT OF SERVICE,
THEN CHILL WATER UNIT VCH4B IS OUT OF SERVICE, AND ALL CHILLED WATER TO
ROOM 100 COOLER VUC2B IS LOST. THIS WILL CAUSE A LOSS OF ELECTRICAL
POWER TO HPIS PUMP P36A.

MASTER
ESCAPE
~~LAST BP~~
PREVIOUS

ROOM COOLING FOR 4.16KV SWITCHGEAR 'A3'

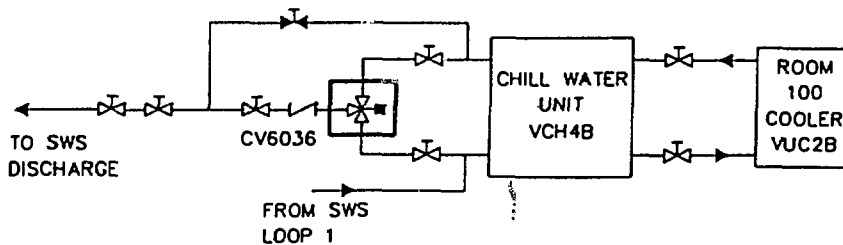


Figure 8

SINGLE FAILURES THAT ARE NOT COVERED
BY TECH SPECS WHEN PUMP P36C IS OUT OF SERVICE

**FAILURE OF ANY OF THESE COMPONENTS IN COMBINATION
WITH THE FAILURE OF PUMP P36C CAUSES THE FAILURE OF THE HPIS**

1. CONTROL VALVE CV6036
[3-WAY VALVE IN THE EMERGENCY SWITCHGEAR ROOM COOLING SYSTEM]
2. CONTROL VALVE CV3808
[SERVICE WATER VALVE UPSTREAM OF HPI PUMP P36A LUBE OIL COOLER]
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[CIRCUIT BREAKER FOR CONTROL POWER TO MAKEUP PUMP
ROOM COOLER VUCM-7A]

.. TO SEE PERTINENT INFORMATION ABOUT VERIFYING THE OPERABILITY
OF ANY COMPONENT ABOVE, MOVE THE CURSOR TO THE COMPONENT NUMBER
AND PRESS RETURN ..

MASTER
ESCAPE
~~LAST BP~~
PREVIOUS
1
2
3
4
5

Figure 9

HPI PUMP P36C IS OUT OF SERVICE

WARNING

SINGLE FAILURES THAT ARE NOT COVERED BY TECH SPECS
EXIST WITHIN THE HPIS SUPPORT SYSTEMS AND CAN CAUSE
THE HPIS TO FAIL.

CAUTION

SINGLE FAILURES THAT ARE COVERED BY TECH SPECS ALSO
EXIST WITHIN THE HPIS AND ITS SUPPORT SYSTEMS AND
CAN CAUSE THE HPIS TO FAIL.

RISK INCREASES BY A FACTOR OF 8.3

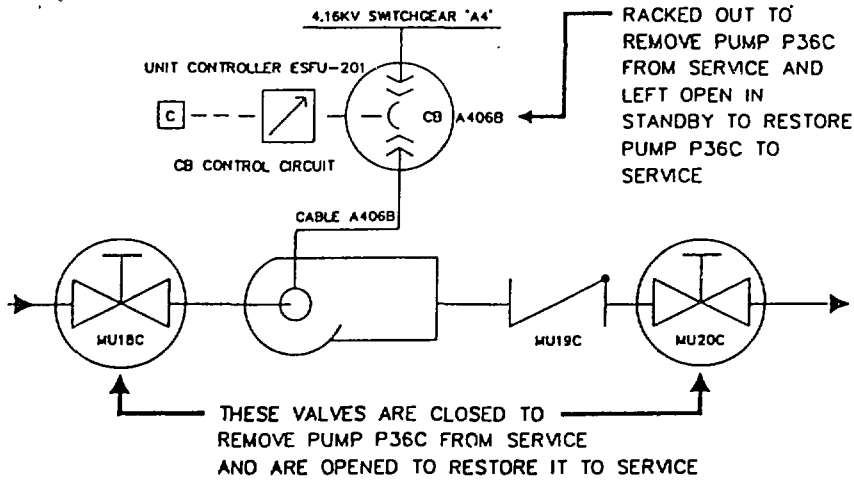
1. HOW DOES THE RISK INCREASE FOR PUMP P36C COMPARE TO THE RISK
INCREASES FOR OTHER COMPONENTS IN THE HPIS?
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PUMPS?
3. WHAT OTHER COMPONENTS ARE REALIGNED TO REMOVE PUMP P36C FROM
SERVICE AND/OR RESTORE IT TO SERVICE?
4. WHAT ARE THE TECH SPECS CONCERNING PUMP P36C?

MASTER
ESCAPE
LAST BP
PREVIOUS
WARNING
CAUTION
1
2
~~3~~
4

Figure 10

COMPONENTS THAT ARE REALIGNED TO REMOVE PUMP P36C FROM SERVICE AND/OR RESTORE IT TO SERVICE

MASTER
~~ESCAPE~~
 LAST BP
 PREVIOUS



•• SELECT COMPONENT USING CURSOR TO SEE INFORMATION FOR VERIFYING CORRECT RETURN TO SERVICE CONDITION ••

Figure 11

CONTINUE
~~ESCAPE~~

PLANT RISK STATUS
 INFORMATION MANAGEMENT SYSTEM

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Figure 12