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Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTENTION: T. R. QUAY

SUBJECT: WESTINGHOUSE RESPONSES TO NRC REQUESTS FOR ADDITIONAL INFORMATION ON THE AP600

Dear Mr. Quay:

Enclosed are the Westinghouse responses to NRC requests for additional information on the AP600 Design Certification program. Enclosure 1 contains responses to 11 follow-on questions pertaining to instrumentation and control modeling in the AP600 Probabilistic Risk Assessment. These follow-on questions were provided in NRC letters dated September 7, 1995, October 18, 1995, and January 22, 1996.

These responses close, from a Westinghouse perspective, the addressed questions. The NRC technical staff should review these responses.

A listing of the NRC requests for additional information responded to in this letter is contained in Attachment A.

Please contact Cynthia L. Haag on (412) 374-4277 if you have any questions concerning this transmittal.

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

/nja

Enclosure
Attachment

cc: D. Jackson, NRC (1 copy enclosures/attachment)
J. Sebrosky, NRC (1 copy enclosures/attachment)
J. Flack, NRC (w/o enclosure/attachment)
N. J. Liparulo, Westinghouse (w/o enclosure/attachment)

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Attachment A to NSD-NRC-96-4688
Enclosed Responses to NRC Requests for Additional Information

**Re: Level 1 PRA - I&C Questions**

Question 1 - pertaining to DSER OI 19.1.3.1-7
Question 1 - pertaining to DSER OI 19.1.3.1-11
Question 1 - pertaining to DSER OI 19.1.3.1-14
Question 1 - pertaining to DSER OI 19.1.3.1-15

720.307 - includes an Attachment 1 to RAI response
720.308
720.310
720.311
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720.313
720.319

**Enclosure 1 to Westinghouse**
**Letter NSD-NRC-96-4688**

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**Enclosure 1 to Westinghouse**
**Letter NSD-NRC-96-4688**

**April 4, 1996**

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Re: RAI Related to DSER OI 19.1.3.1-7 from NRC letter dated September 7, 1995

(part concerning RNS signal from PLS or PMS)

Question 1 (#2810)

Westinghouse needs to correct several inconsistencies or provide an explanation indicating that the apparent inconsistency resulted from a misunderstanding. Several entries in the "System Dependency Matrix" tables, at the end of each specific system chapter, are inconsistent with the "AP600 Support System Interdependency Matrix" table located in Chapter 5. Examples are:

- For the Passive Containment Cooling System (PCS), Table 13-4 on page 13-9 of the PRA, shows that IDS is the support system required to operate AOVs and MOVs. However, PCS-PCT in Table 5-6 on page 5-30 of the PRA does not show that the IDS system is a support system.
- For the Normal Residual Heat Removal System (RNS), Table 17-4 on page 17-10 states that PLS system provides manual actuation logic for pumps, MOVs, etc. However, RNS-RHR and RNS-RNP (Table 5-6 on page 5-33) indicate the PMS system (not the PLS system) provides support.

In addition, Section 21.4.2 refers to subsection 8.3.1 of reference 21-1. Reference 21-1 is the revision 1 fault trees and there is no subsection 8.3.1. The correct reference should be given.

Response:

RNS valves V011, V022, and V023 are controlled by the PMS and are modeled as such in the PRA. Fault trees RNS-IC1, RNS-IC1P, RNS-IC2, RNS-IC2P, RNS-IC4, and RNS-IC4P are correctly modeled as PMS functions.

The RNS pumps are controlled via the PLS. The PRA incorrectly models the PMS as controlling the pumps. Fault tree models RNS-IC3 and RNS-IC3P will be changed in the next PRA revision to model the PLS system as controlling the pumps. Additionally, sections 5 and 17 should reflect the correct I&C support to the RNS components.

Re: RAI Related to DSER OI 19.1.3.1-11 from NRC letter dated September 7, 1995

Question 1 (#2812)

The staff was unable to find in the revised PRA submittal a complete response to DSER Open Item 19.1.3.1-11. Please provide documentation of I&C failure data derived from Westinghouse data or identify specifically where this information can be found.

Response:

The failure rates used in the AP600 PRA I&C modeling, which have been presented to the NRC, are documented in proprietary Westinghouse Calculation Notes that support the I&C modeling in the PRA. This information can be made available for further NRC review.

Re: RAI Related to DSER OI 19.1.3.1-14 from NRC letter dated September 7, 1995

Question 1 (#2814)

The staff was unable to find in the revised PRA submittal the beta factor, or MGL parameter, values used in calculating common cause failure probabilities of I&C hardware components (as requested in the DSER Open Item 19.1.3.1-14). Please provide this information, including sources and related documentation. In addition, please provide detailed documentation of the calculation of probabilities for the most risk-important CCF events (in terms of both baseline and focused PRA results) related to I&C hardware components.

Response:

Beta factors are calculated using the method described in the Rolls-Royce and Associates technical memorandum referenced above in the "Assumptions" discussion. Beta factors range from 0.037 for simple hardware components across division, to 0.083 for microprocessor based boards within divisions.

The Multiple Greek Letter (MGL) method of calculating common cause failures uses the beta factor derived from the Rolls-Royce and Associates method, and the generic gamma value of 0.33 and generic delta value of 0.52 given in the MGL guidebook. The MGL method is used only for the PMS Reactor Trip system common cause calculations and in the PMS IPC common cause calculations. All other common cause failures are calculated using the beta factor method.

The common cause event CCX-EP-SAM, which models common cause failure of the output driver modules in the PMS, is presented here as an example of the common cause calculations. This basic event appears as one of the first I&C components in the risk importance lists. The simple beta factor method is used in calculating this basic event probability. The common cause calculation is performed as follows: A single output driver module has a calculated unavailability of 1.71E-04. The beta factor applied to this component is 0.0504 as conservatively assessed using the Rolls-Royce and Associates technical memorandum. The product of these two terms yields the common cause unavailability of 8.62E-06.

All common cause calculations are documented in the Westinghouse calculation notes supporting the I&C modeling in the PRA and are available for further NRC review.

Re: RAI Related to DSER OI 19.1.3.1-15 from NRC letter dated October 18, 1995

Question 1 (#2898)

The staff was unable to find in the revised PRA submittal how the software common-cause failure probabilities were calculated. The following statement is made (see pages 26-25 and 28-20):

> "The software common-cause failure evaluations are based on a model that incorporates a number of factors that can affect the development and implementation of software modules. This model yields a resultant software common mode unavailability of 1.1E-05 failures/demand for any particular software module, and a software common mode unavailability of 1.2E-06 failures/demand for software failures that would manifest themselves across all types of software modules derived from the same basic design program in all applications."

The above statement does not provide adequate information to the staff to understand how software failures were modeled in the PRA. Please explain the "model" and the "particular software modules" you are referring to in your statement. Also, please explain how the common mode unavailabilities (1.1E-05 and 1.2E-06) were obtained.

Response:

The software common cause failure that models failure of "a particular software module" is intended to model all unique functions such as application level software modules and is applied at each programmable system functional block. Integrated Protection Cabinet (IPC) Reactor Trip subsystems, IPC ESF subsystems, ESF Actuation Cabinets, Protection Logic Cabinets (PLCs) are all examples of these "Programmable system functional blocks." In the I&C modeling, these software common cause events are named CCX-PM#MOD#-SW, and parallel the CCX-PM#MOD# basic events that model the hardware failures in a system functional block. In the current PRA models, the following software common cause events model this type of software common cause failure:

| Basic Event Name | Description |
|---|---|
| CCX-IN-LOGIC-SW | Software common cause across the four divisions of IPC ESF subsystems |
| CCX-PM#MOD1-SW | Software common cause across the two subsystems of the PLC cabinet in division #=A,B,C,D of the PMS. In the next revision of the PRA, all divisions' basic events will be named CCX-PMXMOD1-SW so that this event will sweep across the divisions of PMS as a sensitivity on this event. |
| CCX-PM#MOD2-SW | Software common cause across the two subsystems of the ESFAC cabinet in division #=A,B,C,D of the PMS. In the next revision of the PRA, all divisions' basic events will be named CCX-PMXMOD2-SW so that this event will sweep across the divisions of PMS as a sensitivity on this event. |

| | |
|---|---|
| CCX-PM#MOD4-SW | Software common cause across the two subsystems of the control board multiplexing cabinet in division #=A,B,C,D of the PMS. In the next revision of the PRA, all divisions' basic events will be named CCX-PMXMOD4-SW so that this event will sweep across the divisions of PMS as a sensitivity on this event. |
| CCX-PL#MOD1-SW | Software common cause across the two subsystems of the Control Logic Cabinet (CLC) in control group # of the PLS. |
| CCX-PLMOD3-SW | Software common cause across the four divisions of communications subsystems of PMS IPCs (these feed the PLS signal selection function). |
| CCX-PL#MOD4-SW | Software common cause across the two subsystems of the control board multiplexer cabinet of the PLS. |
| CCX-PL#MOD5-SW | Software common cause across the two subsystems of the Integrated Control Cabinet (ICC) in control group # of the PLS. |
| CCX-PL#MOD6-SW | Software common cause across the two subsystems of the signal selector of the PLS. |

The CCX-SFTW event models common cause failure of the software modules that could potentially be common across multiple applications. Examples of these types of software modules are the common functions modules used to store and retrieve information from memory buffers. This basic event is applied in all PMS and all PLS functions such that this single failure will fail all functions in both systems.

The following text provides information regarding the calculation of these software common cause values.

The formula to evaluate software common cause failure is as follows:

$$U = [\ n * \lambda * Vi * Vt + Pc * Vt'\ ] * C * Pev$$

where:

$n$ = number of instruction lines

$\lambda$ = failure rate per instruction line

$Vi$ = failure probability of and independent analyst to detect the error

$Vt$ = failure probability of the computer testing the high-level source code to detect the error

$Vt'$ = failure probability of the computer testing the compiled machine code to detect the error

Pc = probability of error due to the compiler program

C = probability that the error will cause complete system failure

Pev = probability that a unique input signal combination, presented during the event, will activate the pre-existing software error by causing multiple failure, given that it did not show up during the factory acceptance and periodic surveillance tests.

The common cause failure for software error is independent of the surveillance test frequency, because the test is not designed to discover the particular input conditions that activate the software error.

For evaluation, engineering judgement is applied to assign values to each of these terms, and the sensitivity of this data is analyzed based on the results of the base-line and focused PRA results to verify that the data does not significantly contribute to the total core damage frequency.

The following values are assumed:

n = 5000 lines

λ = 1E-3/instruction

Vi * Vt = a range between 1E-2 and 1E-3. Assumed value is 5E-3. General data reports 2 percent of errors are found during the application of a program. The verification and validation failures for nuclear applications are expected detect more errors than standard software design processes.

Pc * Vt' = 1E-5. These errors are considered to be low on the basis that the compiler program is validated more frequently over a wide range of applications such that the associated failure probability is very low.

C = 0.1. This value defines the fraction of the software errors that causes complete subsystem failure. It is assigned based on the system being designed to be fail-safe (for example, software upsets and processor halts result in a predetermined default state).

Pev = 5E-3. Pev is the sum of two conditions. The first is the probability that the error will be activated during the event, given that it is not activated during functional testing or nuclear test. This is assessed to be between 1E-2 and 1E-3. The second is the probability that the error will be activated during the event because of the concurrence of common cause hardware failure or multiple hardware failures which produce expected and untested input in all redundant components. This is assessed to be less than 1E-3. Pev is therefore assessed to be 5E-3.

Combining these values yields the following:

U = [ 5000 * 1E-3 * 5E-3 + 1E-5 ] * 0.1 * 5E-3 = 1.2E-5/demand

This is the software common cause failure affecting a single programmable functional block. Ten percent of these failures are assumed to be common to multiple programmable functional blocks that are performing different functions, but are developed on the same basic software platform (e.g. shared lower level functions, same high-level language, same compiler). Therefore 1.2E-6 is assigned to software common cause which could fail both the PMS and the PLS.

The remaining 1.1E-5 is assumed to affect identical redundant units because either the failure is in the application code itself, or the intended fail-safe response to the failure is dependent on the application code, or location of the failure with respect to the plant interfaces.

Of the software common cause failures modeled in the PRA, the two most risk significant are the CCX-SFTW and the CCX-IN-LOGIC-SW. The importance increase measure for the CCX-SFTW basic event in the baseline at-power internal initiating events assessment is 838137. If this basic event were to be increased by a factor of 10, the increase in CDF is:

CDF increase = [ new P(f) - old P(f) ] * Imp Inc/100 * CDFbase
= [ 1.2E-5 - 1.2E-6 ] * 838137/100 * 2.4E-7
= 2.4E-8

This translates into a 10% increase in CDF.

The CCX-IN-LOGIC-SW basic event has an importance increase measure of 1335. Therefore, increasing this value by a factor of 10 results in an increase in the base CDF of:

CDF increase = [ new P(f) - old P(f) ] * Imp Inc/100 * CDFbase
= [ 1.1E-4 - 1.1E-5 ] * 1335/100 * 2.4E-7
= 3.2E-10

This translates into a 0.1% increase in the CDF.

Both of these events show a small increase in the CDF for the base-line at-power internal initiating events assessment. The focused PRA shows smaller importance increase measures for the software common cause events, so the impact on the focused PRA CDF is even less. This sensitivity analysis shows that the PRA model is not sensitive to even large increases in the software common cause failure probabilities.

Re: PRA I&C modeling question from NRC letter dated January 22, 1996

Question 720.307 (#3038)

The staff was unable to find in the revised PRA submittal simplified diagrams for the Protection and Safety Monitoring System (PMS) and for the Plant Control System (PLS) as they were modeled in the PRA. The review of the I&C PRA models without simplified process block diagrams is extremely cumbersome, if at all possible. There seems to be significant differences in terminology and designations between the PRA and the SSAR (Chapter 7). Such process block diagrams should show the various subsystems, groups, trains, and divisions modeled in the PRA (with the same terminology and designations used in other parts of the PRA). In addition, simplified diagrams showing important components within each block or subsystem, are needed to determine whether important failures have been modeled and to understand important modeling assumptions as well as their implications. This information was available in revision 0 of the PRA. It should be updated and included in the revised PRA, also.

Response:

A "roadmap," as discussed at the Westinghouse/NRC meeting of February 1, 1996, is provided as Attachment 1 to this RAI. This information, along with SSAR Chapter 7, provides the information requested by this RAI.

Attachment 1 to RAI 720.307 Response

# Discussion of I&C as Modeled in AP600 PRA

## 1. Introduction

This document provides a basis discussion which includes topics such as modeling approach, assumptions, reference to architectural diagrams, and methods of assigning data values to the events modeled as discussed at the February 1, 1996 meeting of Westinghouse and the NRC in Monroeville, PA. In essence, this document provides an overall view or 'map' of the key points and constructions of the AP600 I&C PRA modeling, to aid in understanding and review of the methods that are applied.

Specifically, this document provides the reader with clear direction toward understanding the I&C PRA modeling with respect to the following areas:

- Approach and methods used in I&C Modeling
- Assumptions made in the I&C modeling
- Architectural and functional system descriptions
- Scope of system covered in the I&C modeling
- Mapping of the I&C models to the architectural descriptions
- Application of hardware CMF in the modeling
- Application of software CMF in the modeling
- Results and application of the I&C modeling in the full PRA

## 2. Approach and Methods used in Modeling the AP600 I&C

The I&C systems of the AP600 are modeled in support of the AP600 PRA. Where dependencies on the I&C systems are credited in the system level trees of the PRA, I&C models representing the potential failure contributions of the associated I&C systems are developed. In general, the dependencies on the I&C systems are represented in the form of actuating, controlling, and indicating signals used to support automatic and manual reactor trip, ESF, and plant control functions in response to initiating events. The decision to model these signals is determined from the system level tree development and definitions, which may specify dependence on proper functioning of the I&C.

Although detailed I&C models which reflect the current technology design are implemented in the analysis, the objectives of the full PRA do not include support of design certification based on any particular I&C design implementation or hardware platform. One main reason that the demonstrated level of performance of the I&C per the modeling in the PRA is acceptable in terms of its contributions toward the full PRA, the functionality and associated general hardware assignments, assumptions, bounding conditions, component failure data, and results of the I&C modeling can be assumed to represent allocations of performance requirements that future I&C platforms would be expected to meet in order to continue to support the PRA goals. These points represent the highest level approach philosophy applied throughout the I&C modeling.

The following sections address those functionality and associated hardware assignments, assumptions, bounding conditions, component failure data, and results as they are employed in and obtained from the modeling of the I&C.

## 3. Functionality and Hardware Assignments of the AP600 I&C Modeling

Figure 7.1-1 of the SSAR illustrates the I&C architecure. All of the systems credited in the AP600 PRA are represented in this diagram. Information regarding how the I&C systems function and inter-relate is left to the SSAR and associated system design documentation. However, the following list identifies the basic system and functional groupings addressed in the I&C modeling. Simplified overviews of the systems are provided.

PMS - Protection and Monitoring System

Automatic Reactor Protection
Manual Reactor Protection
Automatic Engineered Safeguards Features (ESF) functions
Manual ESF functions
Indication functions

Overview: The PMS can be represented in a simplified way as a four-way redundant system, with additional internally redundant 'control trains' of ESF output hardware, as required to interface with the plant equipment. Automatic actuations are initiated by plant sensors which are input to the PMS and shared between the appropriate reactor trip and ESF functions. Separate hardware and application software modules are dedicated to the reactor trip and ESF functions. A limited set of software modules, which control fundamental computer operations are common to the reactor trip and ESF functions. Reactor trip outputs are connected to the reactor trip breakers, and ESF outputs are connected to plant equipment or drivers. Manual actuations are received from the control room and connected to the reactor trip breaker circuitry for reactor trip function, and to the 'control trains' of ESF for ESF actuations. Sensor information and other processed information from the PMS is indicated to the operators to support manual operations.

PLS - Plant Control System

Automatic Control with remote (Signal Selector Cabinet - SSC) inputs
Automatic Control with local inputs
Manual Control
Indication functions

Overview: The PLS can be represented in a simplified way as a set of individual internally redundant 'control groups' which are interfaced to various plant equipment. The term 'control group' for the non-class 1E equipment parallels the term 'train' of class 1E equipment. Each of the 'control groups' is similar in hardware design to the trains applied in the PMS ESF applications, and a limited set of software modules controlling fundamental computer operations are also equivalent. The application software of the PLS is unique from that of the PMS. Automatic actuations originate from sensor inputs which are available locally to the control groups, and remotely to the control groups through access to the PMS sensors. Manual actuation signals are received from the control room and connected to the control groups through multiplexing equipment. Sensor information and other processed information from the PLS is indicated to the operators to support manual operations.

DAS - Diverse Actuation System

Auto Reactor Protection
Manual Reactor Protection
Auto ESF functions
Manual ESF functions
Indication functions

Overview: The DAS is treated as a 'black-box' in the I&C modeling. It provides some of the same basic functions as the PMS provides, but in a limited fashion based on the initiating events it is designed to cover as a 'backup' to the PMS. The DAS by design is diverse, including hardware and software, from the PMS and PLS. The only exception to this is that the DAS uses the same sensor types that are used in the PMS to measure a given parameter. Although, the sensors may be of the same type, they are unique sensors for the PMS and DAS, and they are not shared.

In addition to defining the overall I&C functionality and general hardware assignments, a number of more detailed assumptions are made to further define the scope of the I&C systems and analysis. Discussion of these assumptions follows.

## 4. Assumptions Made in the I&C Modeling

Section 26.4.1 documents the high level assumptions regarding the modeling of the I&C systems. There are four basic areas addressed in the modeling of the I&C. These are; Scope and Boundary Assumptions, Generic Modeling Assumptions, Data Development

Assumptions, and Common Cause Failure Assumptions. The following discussion organizes and clarifies these assumptions, and provides additional links between these assumptions and the I&C analysis. Specific discussions which document the assumptions applicable to a particular I&C system follow later in this document.

Scope and Boundary Assumptions

a. The level of detail modeled for the PMS and PLS is limited to the circuit board or line replaceable unit level. The DAS is modeled as a "black-box" and is allocated reliability values based on the system design goals.

b. Wiring and cables are assumed to be available. Typically, failures of this equipment are experienced at termination junctions of transmitting and receiving boards, and failure rates for wiring are typically much lower than transmitting and receiving hardware. Effects of these failures are incorporated into the assessed performance of associated circuit boards. In addition, the level of complexity, coding, and dynamic signaling techniques used in transmission of data (such as deadman timers and on-line diagnostics) throughout the system forces any failures of this type to become uniquely detectable. Effects of these failures is bounded by the performance of transmitting and receiving circuitry.

c. Power supplies to the I&C cabinets are explicitly modeled as a sub-tree in each of the I&C sub-trees.

d. Loss of cabinet cooling to the I&C system cabinets, which could eventually lead to elevated cabinet temperatures, is detected by cabinet temperature sensors that are continuously monitored by the systems. On detection of high cabinet temperatures, the affected system functions assume a predefined default state. To conservatively model the possibility for failure of this mechanism, the contribution for failure of the cabinet fan unit has been included in the modeling of each cabinet subsystem. Also conditional probabilities given fan failures and the coincident failure of the circuits that detect the high temperature have been included as contributions to unavailability in the models.

e. Sensors and sensor taps are explicitly modeled for each I&C subtree.

f. All I&C equipment is assumed to be available at the beginning of the mission.

g. Software failures are explicitly modeled in the fault tree logic.

Generic Modeling

a. Unique I&C subtrees are developed for each component that is required to be actuated by either automatic or manual means via the I&C system. An I&C subtree is defined to model all available I&C system functions capable of actuating the component for a given plant event as defined by the success criteria for the actuated component. For example, some components define successful operation as actuation by any one of the following I&C paths: Automatic PMS, Manual PMS, Automatic DAS, or Manual DAS. For these components, an I&C subtree consists of an AND gate combining the four I&C system paths.

b. For manual actions, the HRA basic event is usually included in the I&C subtree. In some cases in which a single manual actuation is modeled, the operator action is modeled with the actuated component.

c. A modular approach is employed in the modeling of system failures, similar to that used in the other systems modeled in the PRA. A particular basic event may represent a number of component failures that render the particular functional unit (such as an I&C cabinet subsystem) inoperable. The detailed system modeling descriptions below describe the basic events in the I&C system.

d. No contribution due to random software failure is considered, as software failure falls solely under the category of common mode design failures. Appropriate nodes reflecting common mode software failure of individual software implementations within the system are included in the modeling, Development of software common mode models is discussed in section 26.5.4.

Data Development

Refer to sections 26.5.3 and 26.5.5 of the PRA for the method of computing basic event probabilities in the I&C analysis.

a. All sensors are conservatively assumed to be non-repairable at power. Repair is assumed to occur during refueling, which is assumed to be at 24 month intervals.

b. Component failure rates used in the data development are derived from a combination of specified component reliability, conservatively estimated component reliability based upon Military Handbook calculations, and operational data. These failure rates are documented in Westinghouse calculation notes. The latest available operating data shows that the data assignments are conservative with respect to the actual performance of these components. In most cases, the latest available operating data shows an improvement in component reliability by factors of from two to ten times.

c. Repair time for all I&C components (except sensors) is assumed to be 4 hours.

d. System self-diagnostics tests are conservatively assumed to be automatically completed every 5 minutes. The effectiveness of these diagnostics depends upon the module and function under consideration.

These diagnostic effectiveness measures have been computed based upon detailed Failure Mode and Effect Analyses (FMEA) and Functional Block Analyses (FBAs) for each module included and each function performed in the system. The FMEAs and FBAs assess, for each postulated failure mode, whether the system diagnostics detect the failure, and/or whether the system takes a predefined, default action in response to the failure. Those failure modes that may be undetected by system diagnostic or may adversely affect the intended system function are identified and those components' failure rates are summed. Using this summed failure rate and the total board failure rate, a ratio is developed that represents the effectiveness of the system in taking "safe" action in response to system failures. This diagnostic effectiveness term is expressed in terms of a "fail-safe percentage". This method presents a conservative, bounding assessment of the effectiveness of diagnostics based on both the qualitative assessment of the failure modes, and the quantitative assigning of failure rates to those failure modes that may be undetected by system diagnostic or may adversely affect the intended system function.

The results of the FMEAs and FBAs show that the effectiveness of most functions in the system is in excess of 90 percent.

e. Automatic testing performed by the automatic tester subsystem comprehensively tests all boards every 3 months. A manual starting of the automatic tester is required. This 3 month test interval is assumed to bound the potential down time associated with those failures that are not detected by automatic self-diagnostic routines continuously run by the system. Also, due to the speed at which the automatic tester can test the equipment, no additional scheduled maintenance unavailability is included into the component unavailabilities.

Common Cause Failures

a. Common cause failure assignments are based on similarity in design and function of component or system module (including software). Coupling mechanisms considered in the analysis include functional similarity, design defects, environmental effects. Some defense mechanisms against common cause failure include separation, operational testing, maintenance, and immediate detectability of failure provided by the on-line diagnostics. Specifics on the common cause failure assignment are discussed below.

b. Hardware common cause failure evaluations are based on the multiple greek letter method, which uses beta, gamma, and delta terms to represent the conditional probabilities of the second-, third-, and fourth-order failures due to common cause. The Rolls-Royce and Associates technical memorandum "Numerical Values for Beta Factor Common Cause Failure Evaluation" [1] is used to develop the common cause beta factors for the I&C hardware components. It should be noted that the method used in calculating MGL factors for the hardware CCF include a substantial contribution due to the inclusion of software in the design. This inclusion is deliberately left in the analysis as an added measure of conservatism when considering potential impacts of software failure on the system.

c. The software common cause failure evaluations are based on a model that incorporates a number of factors that can affect the development and implementation of software modules. This model yields a resultant software common mode unavailability of 1.1E-05 failures/demand for any particular software module, and a software common mode

[1] RRA/7692, "Numerical Values for Beta Factor Common Cause Failure Evaluation-STF," Rolls-Royce and Associates Limited Technical Memorandum, February, 1986.

unavailability of 1.2E-06 failures/demand of software failures that would manifest themselves across all types of software modules derived from the same basic design program in all applications. The software common mode unavailability of 1.2E-06 failures/demand is applied across the PMS and PLS system, representing an absolute upper bound on software reliability for the two systems. The "black-box" apportionment for reliability of the automatic DAS functions includes unavailability of the system due to software failure. By design specification, the DAS software is diverse from that of the PMS.

d. The assessment of the software common mode failures (CMF) is based on comparing the similarities of various systems with the defenses against CMF that are incorporated in development and implementation of the design. The following discussion presents an overview of the defenses that are prevalent in the I&C software design.

The software design process is the most important contributor to software CMF. Before addressing the specific I&C software defensive measures it is useful to discuss how they should be viewed. It is the goal of the analysis to assure that the CMF probability of the I&C software is sufficiently below an acceptable level, as defined by the full PRA goals. No defensive measure need be perfect. Rather, even if the defensive measures are assumed to be only moderately effective and independent, the successive application of numerous defensive measures will reduce the probability of CMF below the acceptable level. This does not necessarily mean that a defensive measure is only moderately effective. It means that it need be only moderately effective to achieve the established acceptable reliability. The following sections describe a simple conceptual model which is applied to qualitatively address the defenses against, and resultant potential for CMF in the I&C design

Simple Conceptual Model

A simple conceptual model is be used to demonstrate that the design process defenses and the defenses included in the I&C software operation limit the probability of CMF because of software error being sufficiently below the acceptable level. This model can be thought of as a series of software error filters with each successive filter reducing the number of potential software errors. The effectiveness of the filtering is based on the effectiveness of each stage and the independence of the various stages. No claim is made about perfection at any individual stage. Indeed, if perfection of any individual stage were possible, then CMF would not be an issue.

Structured Design Process Followed

Current design standards require a project design structure where the phases are formalized and none of the identified phases are omitted. The project structure for the complete I&C structure is formalized in the Westinghouse document "System Development / Implementation Process" (SYSDIP). The design standards require that software requirements be generated and that software functional requirements specifications be available before the design and coding phase of the project development begins. SYSDIP includes these phases.

Design Reviews Held

SYSDIP prescribes major steps in the design process. It is practice during the software design process to hold design reviews with peer technical experts before the completion of each project phase. These reviews are formally documented with meeting minutes.

Design Implementation Constrained

The design standards provide recommendations and requirements for software design and coding that is as error-free as possible from the very beginning and which can be easily verified. The software meets these requirements and conforms to the recommendations. Examples of these software implementation restrictions are as follows:

1. Programs and program parts shall be grouped systematically.
2. Modules shall be clear and intelligible.
3. Operating system use shall be restricted.
4. Technical process behavior influence on execution time shall be kept low.
5. The use of interrupts shall be restricted.
6. Simple arithmetic expressions shall be used instead of complex ones.
7. Branches and loops should be handled cautiously.
8. Subroutines and procedures should be organized as simply as possible.
9. Nested structures shall be handled with care.
10. Simple addressing techniques shall be used.
11. Data structures and naming conventions shall be used uniformly throughout the system.
12. Dynamic instruction changes should be avoided.

Design Testing

This is an explicit project phase in the development of the software prior to the release for verification. Intermediate tests are performed during the software development. That is, each module is thoroughly tested before is integrated into the next level. Westinghouse spends a considerable effort and expense to support this phase of the program. Examples of this are the use of sophisticated test tools such as in-circuit emulators and the construction of full scale generic prototypes.

Safe Failure Modes

The technique of designing systems and components which predominantly fail to a safe mode is well established. In addition to being a defense against independent random failures, it is also relevant to CMF defense. For the complete system it is possible to eliminate by design concern about certain failures.

In the specific case of the I&C software, if a module detects an error or a failure, a well defined output is produced. This output will result in an application specific safe action. If the error of failure is deemed to be fatal, the action is to stop microcomputer execution which results in its outputs defaulting to the safe state.

The I&C software contains two types of error or failure checks. Hardware diagnostics check for errors of failures in the software operating environment, and defensive programming techniques provide self supervision. Plausibility checks of intermediate results are included in the I&C software. Examples of these checks are array bound checks and range checks on input variables, intermediate parameters, and output variables.

These detection mechanisms are separate from the source of the error of failure, and they have no knowledge of the source of the error of failure. Therefore, they are effective whether the source of the error of failure is random or common mode.

A specific I&C example can be seen in the implementation of the data link and data highway communications software. The thorough end-to-end checks associated with the communication of data on these data links combined with the application specific safe failure modes eliminate from concern by design virtually all failures associated with the communication of safety information.

Functional Diversity

If different plant parameters can be identified and measured, from which automatic protection can be independently initiated to prevent the hazard developing, then a form of defense against CMF known as functional diversity is available. The inherent nature of the AP600 design together with the appropriate plant parameter measurements and the safety system actuation has the potential for functional diversity.

The I&C internal architecture is structured to take advantage of this functional diversity potential. Aspects of functional diversity which are applied in the I&C design have been analyzed by the NRC in topical report, NUREG-0493, "A defense-in-Depth and Diversity Assessment of the RESAR-414 Integrated Protection System". In the I&C design, reactor trip actuations initiate independent of (i.e., use separate hardware and software elements) the ESF and PLS control functions. Furthermore, within both the reactor trip and ESF actuation, multiple independent functions (which again use separate hardware and software elements) are provided to protect against the same plant hazard.

Software Verified

This is an explicit required phase in the development of the I&C software which meets the requirements of the NRC. Westinghouse has added automated software verification analysis and test tools to the software verification process. These automated test tools provide an objective measure of certain software metrics such as code complexity and test coverage. The Westinghouse verification test coverage requirement is 100 percent equivalent path coverage at the module level. That is, if a path segment cannot be executed by the constructed set of test cases, then the reason must be analyzed and stated.

System Tested / Verified

These are explicit required phases of the development of the I&C software. Westinghouse has constructed full scale prototypes to facilitate the system validation testing. The I&C

functional tests include application specific computer system validation tests that are run on both the prototype and the production equipment.

Feedback of Experience

The I&C software has been designed to leverage feedback from operational experience. Most of the I&C software is associated with the Common Functions. The flexibility designed into the Common Functions provides opportunity for operation experience to be reflected. Operating experience of Westinghouse designs applicable to the AP600 I&C show basically no occurrences of CMF events which adversely affected plant safety.

Good Operator Interfaces

The I&C design includes features and functions that are explicitly included to improve maintenance. These features include test and maintenance facilities, operational bypasses, and start-up vetoes. These features together with the administrative operational controls can make a significant contribution to the system immunity from CMF from operational influences. Practical experience indicates that these features are extremely important in the long term operation of the equipment.

Some of these features make the operation of the software visible to the operator. For example, numerous internal variables and status information are transmitted out of the I&C over optical data links for indication in the control room.

Periodic Proof Testing

US NRC requirements require proof testing of protection equipment at a frequency that assures that system reliability is maintained. That is, it is an essential feature of a protection system that dangerous failures are not allowed to persist.

The I&C has an integrated functional tester that performs the periodic proof testing in a controlled manner thereby eliminating the potential for introducing causes of CMF that have been traditionally associated with manually performing this type of testing. The tests performed by the tester functionally test the correct operation of all the automatic safety functions which includes the correct operation of the software.

Defensive Measures Analysis Conservatism

The defensive measures associated with the software design and the software operation are to a great depth. Actually, there are more than the ones listed in this discussion. The defensive measures are applied by Westinghouse in a very systematic manner. Therefore, each measure should be very effective.

Even assuming that each measure is only moderately effective and independent, the probability of CMF due to software error is estimated to be well below an acceptable level. A backward calculation can show that on the average, a defensive measure need only be 60% effective to meet a reliability goal of 1.0E-05 f/d. Again, this does not mean that the measures are only 60% effective. It means that they need only be 60% effective to achieve such a goal.

Design Approach Philosophy

The defensive measures discussed in the above sections are more than just a CMF analysis. They represent a design approach philosophy that is followed by Westinghouse throughout I&C system design efforts.

This approach recognizes that the design of the I&C requires the simultaneous maximization of many goals. In many cases, these goals are not mutually exclusive and therefore trade-offs may be required. With this approach, perfection of any specific design feature is not a requirement. It is Westinghouse's view that trying to achieve perfection of a particular feature at the expense of other features may be detrimental to the safety system design.

Conclusion

The Westinghouse approach to the I&C design has always recognized that there are two components to the I&C reliability. The component associated with hardware failures and the component associated with design correctness have been carefully considered throughout the design process.

The techniques for quantifying hardware failures are well established, and the results of the I&C modeling in the PRA are exemplary of this. However, techniques for quantifying design correctness are not well established. The discussion above indicates that the potential for CMF due to design errors for the I&C is far below acceptable goal levels. The fact that the quantitative analysis of the I&C CMF contributions produces results that are below the acceptable goal level, but not further below the acceptable level is a result of the conservative approach taken in the quantitative modeling of CMF.

While the above points summarize the assumptions made which are applicable to the overall I&C modeling, the following sections present the methods by which specific implementations of common mode failure, hardware and software assignments, and data values are made in the I&C modeling.

## 5. Common Mode Failure Overview for the I&C Systems

This discussion presents the common mode failure considerations across systems. These common mode failure events present the more limiting I&C systems' failures when considering accident sequences that credit multiple I&C mitigating functions. The term "more limiting" is used in this statement because these are not necessarily the most limiting failures in all cases. Some accident sequences in the PRA credit only specific I&C functions, in which case function specific common cause and random failures can be most limiting. All system specific common mode failures are discussed in the sub-sections dedicated to each specific system.

Areas of the I&C where Common Mode Failure is considered

The modeling of Common Mode Failure (CMF) is divided into two basic categories within the modeling of the I&C. These are Hardware CMF and Software CMF. The application of CMF to these categories in the I&C models is based on evaluation of the attributes of the design, combined with an evaluation of the defenses available in the system and design processes to preclude or minimize the potential for CMF. These attributes include the level of design separation, similarity, complexity, and analysis applied, the level of associated operational procedures and training, and environmental effects and control, and testing. Classically, there exists the potential for CMF between any two or more components or functions of a system in that those components and functions may share some similarities of design or application, such that a failure or unplanned response in one component or function could occur equivalently in all other components or functions with the same design or application. There are areas of and within the PMS, PLS, and DAS that do share some design, application, and functional attributes. However, a substantial amount of defense against CMF, and non-default failure in general, is contained within the I&C design to protect against these events. Each of these areas has been identified and evaluated against the available defenses in the I&C analysis to determine the level of CMF contribution that is appropriate in each case. The potential areas for CMF, associated defenses and assumptions, and the resultant modeling for each of the systems is presented in the following text.

PMS

As stated before, the PMS can be represented in a simplified way as a four-way redundant system, with additional internally redundant 'control trains' of ESF output hardware, as required to interface with the plant equipment. Automatic actuations are initiated by plant sensors which are input to the PMS and shared between the appropriate reactor trip and ESF functions. Separate hardware and application software modules are dedicated to the reactor trip and ESF functions. A limited set of software modules, which control fundamental computer operations are common to the reactor trip and ESF functions. Reactor trip outputs are connected to the reactor trip breakers, and ESF outputs are connected to plant equipment or drivers. Manual actuations are received from the control room and connected to the reactor trip breaker circuitry for reactor trip function, and to the 'control trains' of ESF for ESF actuations. Sensor information and other processed information from the PMS is indicated to the operators to support manual operations.

The following points identify the potential areas for CMF within the PMS, the assumptions, and resultant application of CMF in the PMS I&C modeling.

Sensors

> The sensors that are used to provide process signal inputs to the PMS are four-way redundant.
>
> The sensors do not have any built in defense against CMF. Also the sensors are in environments that are relatively uncontrolled, and there is a reasonable potential for sensors to be exposed to excessive or unexpected inputs. Therefore, hardware CMF

contributions are applied across the four sensor groups for each application where equivalent sensor types are used. Note that the I&C systems assessments explicitly model the sensors used in the function modeled and include common mode failures assigned based on sensor type. These sensor common mode failures are modeled in each of the systems (PMS, PLS, and DAS) and are capable of defeating the functions in all three systems. In addition to modeling all sensors used in automatic protection functions, key sensors used in the operators' diagnoses of plant events are modeled, showing all potential commonality in the automatic and manual protection functions. Diversity in the sensor types used in different protective functions minimizes the effects of sensor common mode failures.

Integrated Protection Cabinets (IPC)

The four redundant IPCs of the PMS are each comprised of a number of subsystems. These subsystems can be divided into three basic groups; Reactor Trip, ESF, and Communications (Communications supports Indication and PLS information). The hardware, and a limited set of common functions software, and the application software within each of these subsystems is common across the four IPCs. A limited set of hardware and common functions software is common across the Reactor Trip, ESF, and Communications subsystems internal to each IPC.

The subsystems of the IPCs have a number of defenses against CMF built into them as part of their design. Due to the level of diagnostics and self-checks performed by these and other independent downstream systems, it is very unlikely that a failure of any type will go undetected. Detectable failures result in preferred default states for the system, which are generally directed toward maintaining plant safety. Additionally, the four IPCs are separated by physical barriers, which further reduces the potential for CMF. Although these features of the design, and operating experience indicate that hardware CMF across the subsystems of the IPCs is expected to be negligible, the analysis of the I&C conservatively includes IPC subsystem hardware CMF contributions. There are two primary reasons for this conservative application. First, the IPCs receive process signals from the sensors. These values are relatively uncontrolled, and there is a reasonable potential for IPCs to be exposed to excessive or unexpected inputs that were not anticipated in the design. Second, a significant amount of the information that is processed by the IPCs is distributed to the ESF and PLS systems for further processing. Failures IPCs to distribute reliable information to these systems would be manifested as a CMF event across those systems. Although unlikely, these two reasons are the basis for inclusion of IPC subsystem hardware CMF contributions in the model.

The software that is included in the IPCs can be divided into two basic categories. These are common functions software, and application software. Common function software controls fundamental processor functions such as I/O, processing, communications, and other basic functions that are performed by standard computer systems. These functions and their associated common functions software is repeated across the majority of the subsystems throughout the system, as they are all implemented on the same general platform. The application software, on the other hand, controls the actual algorithms, protective, and actuating functions that the systems are designed to provide. The application software is generally different for every subsystem type, and is not the same or implemented across the entire system, as each subsystem is typically dedicated to a specific group of functions. CMF of software is primarily considered to account for potential deficiencies in the design of the software which could be manifested as failures in operation.

To account for the inclusion of common functions software in the IPCs, a CMF contribution has been included in the I&C modeling, that affects all subsystems of the IPCs. It should be noted that this same contribution also affects all ESF and PLS subsystems. The common functions software CMF contribution is labeled: CCX-SFTW in the analysis. Again, this common mode failure models failures in the common software elements between the PMS Reactor Trip and ESF functions, and all PLS functions. This software common mode failure event is defined to be common to both automatic and manual functions of both of these systems, and therefore defines an absolute upper bound on reliability of any combination of these two systems. By design specification, the DAS is not susceptible to the same software common mode failures. Section 26.5.4 provides further detail on software common mode failure.

To account for the inclusion of application software in the IPCs, a CMF contribution has been included in the I&C modeling, that affects all implementations of the same subsystem that perform equivalent functions. While this CMF contribution affects modules of the same type within the IPCs, it appropriately does not apply across other modules in the IPCs, ESF, or PLS systems.

Reactor Trip Breakers

There are eight reactor trip breakers with four pairs being connected to the trip outputs of the IPCs, from which the configuration forms a two-out-of-four trip logic. The eight reactor trip breakers are identical in design and application with limited protection against CMF events.

A hardware CMF contribution is applied across all the reactor trip breakers to account for the potential of a CMF event that could disable the reactor trip function.

ESF 'control trains'

The ESF 'control trains' are each internally redundant, and equivalent trains are implemented to achieve ESF control redundancy and separation. The subsystems of the ESF 'control trains' have a high degree of defenses against CMF built into them as part of their design. Due to the level of diagnostics and self-checks performed by these and other independent downstream systems, it is very unlikely that a failure of any type will go undetected. Detectable failures result in preferred default states for the system, which are generally directed toward maintaining plant safety. Additionally, the ESF 'control trains' are separated by physical barriers, which further reduces the potential for CMF. All inputs to the ESF 'control trains' are controlled, as they are received from upstream systems which only produce a defined set of outputs, even under failed conditions, which leaves a negligible potential for ESF 'control trains' to be exposed to excessive or unexpected inputs that were not anticipated in the design. As these features of the design, and operating experience indicate that hardware CMF across the subsystems of the ESF 'control trains' is expected to be negligible, the analysis of the I&C therefore does not includes ESF 'control' train subsystem hardware CMF contributions at the train level. An exception to this is evidenced in the CMF treatment of the output boards of the ESF 'control trains', which does have a CMF contribution that affects all trains. Additionally, CMF contributions have been included in the I&C modeling to account for CMF events that could occur across subsystems within the same train. This accounts for the possibility of spatially coupled events within a given cabinet.

The output boards of the ESF 'control trains', although covered by significant output loop tests and diagnostics, are the last stage in any given ESF functional channel through the I&C. As there are no downstream I&C components which could be used to detect faults of the output boards, and as the output boards are directly interfaced with other plant equipment and drivers, there is the potential for the output boards to experience unanticipated or excessive loads across multiple output boards causing a CMF event.

Therefore, hardware CMF contributions are included in the I&C modeling to account for the potential of a CMF event occurring across multiple ESF output boards, across any trains. Note that the output boards of the ESF, PLS, and DAS systems are all diverse from each other and have no CMF potential between them.

As stated above, a CMF contribution to account for common functions software is included that affects all subsystems of the PMS and PLS including the ESF 'control trains'. While the application software CMF events are currently modeled to only reflect effects within a given ESF 'control train', to account for the functional differences across ESF trains, all subsequent modeling revisions to the PRA I&C models will conservatively include a contribution to represent application software CMF that occurs within and across all ESF trains to evaluate the sensitivity of the PRA to ESF 'control train' application software CMF. The specific applications of this sensitivity study are identified later in this document.

PLS

As stated before, the PLS can be represented in a simplified way as a set of individual internally redundant 'control groups' which are interfaced to various plant equipment. The term 'control group' for the non-class 1E equipment parallels the term 'train' of class 1E equipment. Each of the 'control groups' is similar in hardware design to the trains applied in the PMS ESF applications, and a limited set of software modules controlling fundamental computer operations are also equivalent. The application software of the PLS is unique from that of the PMS. Automatic actuations originate from sensor inputs which are available locally to the control groups, and remotely to the control groups through access to the PMS sensors. Manual actuation signals are received from the control room and connected to the control groups through multiplexing equipment. Sensor information and other processed information from the PLS is indicated to the operators to support manual operations.

The following points identify the potential areas for CMF within the PLS, the assumptions, and resultant application of CMF in the PLS I&C modeling.

Sensors

There are two basic groups of sensors available to the PLS. The first group of sensors is shared with the PMS, and are as presented above, four-way redundant. Therefore the same CMF treatment of sensors as is presented for the PMS is also applicable here. The second group of sensors are local to the PLS. These sensors are not always redundant and are directly connected to the 'control group' cabinets. This attribute does not preclude the possibility for CMF events of these sensors, and they too are treated similarly to that of the PMS.

Therefore, hardware CMF contributions are applied across the PLS sensors at all points of redundancy for each application where equivalent sensor types are used.

PLS 'Control Groups'

The PLS 'control groups' are each internally redundant. The subsystems of the PLS 'control groups' have a high degree of defenses against CMF built into them as part of their design. Due to the level of diagnostics and self-checks performed by these and other independent downstream systems, it is very unlikely that a failure of any type will go undetected. Detectable failures result in preferred default states for the system, which are generally directed toward maintaining plant safety. Additionally, the PLS 'control groups' are separated by physical barriers, which further reduces the potential for CMF. All inputs to the PLS 'control groups' are controlled, as they are received from upstream systems which only produce a defined set of outputs, even under failed conditions, which leaves a negligible potential for PLS 'control groups' to be exposed to excessive or unexpected inputs that were not anticipated in the design. As these features of the design, and operating experience indicate that hardware CMF across the subsystems of the PLS 'control groups' is expected to be negligible, the analysis of the I&C therefore does not include PLS 'control group' subsystem hardware CMF contributions across the different 'control groups'. An exception to this is evidenced in the CMF treatment of the output boards of the PLS 'control groups', which does have a CMF contribution that affects all trains. Additionally, CMF contributions have been included in the I&C modeling to account for CMF events that could occur across subsystems within the same control group. This accounts for the possibility of spatially coupled events within a control group.

The output boards of the PLS 'control groups', although covered by significant output loop tests and diagnostics, are the last stage in any given PLS functional channel through the I&C. As there are no downstream I&C components which could be used to detect faults of the output boards, and as the output boards are directly interfaced with other plant equipment and drivers, there is the potential for the output boards to experience unanticipated or excessive loads across multiple output boards causing a CMF event.

Therefore, hardware CMF contributions are included in the I&C modeling to account for the potential of a CMF event occurring across multiple PLS output boards, across any trains. Note that the output boards of the ESF, PLS, and DAS systems are all diverse from each other and have no CMF potential between them.

As stated above, a CMF contribution to account for common functions software is included that affects all subsystems of the PMS and PLS including the PLS 'control groups'. The application software CMF events are modeled to only reflect effects within a given PLS 'control group' as significant functional diversity is applied across the PLS 'control groups'.

DAS

As stated before, the DAS is treated as a 'black-box' in the I&C modeling. It provides some of the same basic functions as the PMS provides, but in a limited fashion based on the initiating events it is designed to cover as a 'backup' to the PMS. The DAS by design is diverse, including hardware and software, from the PMS and PLS. Therefore the DAS contributions included in the I&C modeling contain their own internal CMF contributions, but no DAS CMF contribution affects, or is affected by any other systems. The only exception to this is that the DAS uses the same sensor types that are used in the PMS to measure a given parameter. Although, the sensors may be of the same type, they are unique sensors for the PMS and DAS, and they are not shared. Therefore the same CMF treatment of sensors as is presented for the PMS is also applicable here, and hardware CMF contributions are applied across the DAS sensors at all points of redundancy for each application where equivalent sensor types are used.

## 6. Specific Systems Discussions

The following I&C functions are discussed below:

- PMS Reactor Trip
- PMS Engineered Safety Features
- DAS Reactor Trip and ESF
- Plant Control System Functions

In each sub-section below, references are made to applicable SSAR sections and figures to aid in the understanding of the modeling in the PRA. The basic events that model the above I&C functions are defined, along with important assumptions and common cause failure definitions. After the following subsections, results for each of the generic functional models are presented.

## 6.1. PMS Reactor Trip

The equipment involved in the PMS reactor trip function is shown in simplified block diagrams in figures 7.1-2, 7.1-3, 7.1-4, and 7.1-7 of the AP600 SSAR. The equipment involved is sensors and manual inputs, Integrated Protection Cabinets (IPCs) including the Automatic Trip Logic, and Reactor Trip Switchgear.

There are two specific PMS reactor trip cases utilized in the level 1 analysis: RTPMS and RTPMS1. These trees model failure to trip the reactor either manually or automatically using the low steam generator or the high pressurizer pressure automatic reactor trip functions.

The basic events used in the reactor trip models are derived from a proprietary version of the reactor trip system for the PMS. Portions of the proprietary reactor trip tree were quantified and the results were assigned to the modular basic events in the non-proprietary version of the fault tree. This process forms the basis for the data values used in the non-proprietary version of the PMS reactor trip fault trees. The non-proprietary modular basic events that model the components of the PMS reactor trip system are:

| Basic Event | P(f) | Description |
|---|---|---|
| PMS-BREAKER1A&2A<br>PMS-BREAKER3A&4A<br>PMS-BREAKER1B&3B<br>PMS-BREAKER2B&4B | 3.54E-06 | Models the specific failure combinations of the automatic trip function that fail the appropriate path in the breaker logic shown in SSAR figure 7.1-7 (where the 1,2,3,4 designation in the basic event name refers to division A,B,C,D in the figure; and the A,B designation in the basic event name corresponds to breaker 1,2 in the figure). These events account for all random failures of the sensors, IPCs, Automatic Trip Logic, and the breakers. |
| CCX-SFTW | 1.20E-06 | This common cause software event models all software failures that can affect operations in both the PMS and Plant Control System (PLS). This software common cause failure defeats both the Reactor Trip and ESF functions of the PMS. |
| CCX-PMS-HARDWARE | 7.89E-05 | Models the sum of the common cause failures affecting the IPCs and Auto Trip Logic. |
| CCX-PMS-SENSORS | 4.04E-08 | Models the sum of the common cause failures of the sensors used in the automatic reactor trip functions. |

| Basic Event | P(f) | Description |
|---|---|---|
| RCX-RB-FA | 8.10E-06 | Models common cause failure of the reactor trip breakers to open on demand. |
| ATW-MAN0# | 5.20E-03 | Models failure of the operator to manually trip the reactor (HRA section documents these basic events). |
| ALL-IND-FAIL | 1.00E-06 | Models failure of all sources of indication that the operator uses as cues for manual actions. The "Indication" discussion in section 26.1 of the PRA discusses the assumptions for this basic event. |
| PMS-RTSWITCH | 3.00E-05 | Models failure of the manual reactor trip switch and associated wiring used by the operator to achieve a manual reactor trip. |
| PMS-RTBREAKERS | 1.33E-15 | Models random failures of the reactor trip breakers. This failure mode is addressed separately from the PMS-BREAKER##&## basic event because failures of the breakers will fail both the automatic and manual means of tripping the reactor via the PMS. |

## 6.2. PMS Engineered Safety Features

The equipment involved in PMS ESF actuation is shown in simplified block diagrams in figures 7.1-2, 7.1-5, 7.1-6, and 7.1-9. The equipment involved is sensors and manual inputs, Integrated Protection Cabinets (IPCs), ESF Actuation Cabinets (ESFACs), Protection Logic Cabinets (PLCs), and control board multiplexers. Section 7.3 of the SSAR provides the details of the PMS ESF operation.

Many ESF functions are modeled in the PRA. This discussion is directed at the common elements in all PMS ESF functions, namely the IPCs, ESFACs, PLCs, and control board.

Integrated Protection Cabinet (IPC) modeling

Section 7.1.2.2.6 of the AP600 SSAR discusses the ESF subsystems of the PMS IPCs. Fault trees AESIPC[B,P] model the IPC functions. The following basic events are used in modeling the ESF subsystems of the IPCs:

| Basic Event | P(f) | Description |
|---|---|---|
| PMAMOD31<br>SUB-IDAEA1<br>SUB-SENS1 | 5.02E-03 not including sub-trees | Division A IPC subsystem for ESF inputs random hardware failures. Sub-tree IDAEA1 models the class 1E power to the subsystem. Sub-tree SENS1 models the particular sensor random failures that provide inputs to the automatic ESF function. |
| PMBMOD32<br>SUB-IDBEA1<br>SUB-SENS2 | 5.02E-03 not including sub-trees | Division B IPC subsystem for ESF inputs random hardware failures. |
| PMCMOD33<br>SUB-IDCEA1<br>SUB-SENS3 | 5.02E-03 not including sub-trees | Division C IPC subsystem for ESF inputs random hardware failures. |
| PMDMOD34<br>SUB-IDDEA1<br>SUB-SENS4 | 5.02E-03 not including sub-trees | Division D IPC subsystem for ESF inputs random hardware failures. |
| CCX-INPUT-LOGIC | 1.03E-04 | Common cause failure of the hardware portions of the ESF input circuitry (PM#MOD3# common cause failure). |
| CCX-IN-LOGIC-SW | 1.10E-05 | Common cause failure of the software portions of the ESF input function. |
| SUB-CCXSNRS1 | sub-tree | Sub-tree that models the sensor common cause failures for the ESF function modeled. |

Engineered Safety Features Actuation Cabinet (ESFAC) modeling

Section 7.1.2.3 of the AP600 SSAR discusses the ESFAC subsystems of the PMS. Figure 7.1-5 illustrates an ESFAC. The Automatic Tester subsystem and Communication subsystem are not modeled in the PRA. The ESFAC failure modes are captured in the AESOUT[A,B,C,D][B,P] fault tree models. The following basic events are used in modeling the division A ESFAC. The other divisions are modeled the same way, with the appropriate division letter in the place of the "A" in PMAMOD:

| Basic Event | P(f) | Description |
|---|---|---|
| PMAMOD21<br>SUB-IDAEA1 | 4.07E-03<br>sub-tree | Models subsystem 1 of the ESFAC cabinet for division A. Sub-tree IDAEA1 models the class 1E power source for subsystem 1. |
| PMAMOD22<br>SUB-IDAEA2 | 4.07E-03<br>sub-tree | Models subsystem 2 of the ESFAC cabinet for division A. Sub-tree IDAEA2 models the power source for subsystem 2. |
| CCX-PMAMOD2 | 3.04E-04 | Models the common cause failures across the two subsystems of the division A ESFAC. |
| CCX-PMAMOD2-SW* | 1.10E-05 | Models the common cause failures for the division A ESFAC software modules. This software common cause fails all functions performed in this cabinet. |
| CCX-SFTW | 1.20E-06 | This common cause software event models all software failures that can affect operations in both the PMS and Plant Control System (PLS). This software common cause failure fails both the Reactor Trip and ESF functions of the PMS. |

* Note that PRA modeling in revision 7 PRA includes a sensitivity analysis on this software common cause model in which each division's software common cause failure event (CCX-PMAMOD2-SW, CCX-PMBMOD2-SW, CCX-PMCMOD2-SW, and CCX-PMDMOD2-SW) will be renamed to CCX-PMXMOD2-SW so that this software common cause event fails all trains of ESFAC cabinets.

Protection Logic Cabinet (PLC) modeling

Section 7.1.2.3 of the AP600 SSAR discusses the PLC subsystems of the PMS. Fault trees AESOUT[A,B,C,D][B,P] and MESOUT[A,B,C,D][B,P] model the functions of the PLC. The following basic events are used in modeling the division A PLC subsystems of the PMS. The other divisions are modeled the same way, with the appropriate division letter in the place of the "A" in PMAMOD for the basic events below:

| Basic Event | P(f) | Description |
|---|---|---|
| PMAMOD11<br>PMA0301ASA<br>PMA0301BSA<br>SUB-IDAEA1 | 2.09E-03<br>1.16E-03<br>1.16E-03<br>sub-tree | These events model failures in subsystem 1 of the division A PLC. Events PMA0301ASA and PMA0301BSA model random failures of logic processors 1A and 1B in subsystem 1, respectively. PMAMOD11 models all other random hardware failures in subsystem 1 of the division A PLC, including the data highway transceiver and controller, the bus, the bus monitor, internal power supply, and cabinet fan. Sub-tree IDAEA1 models the external class 1E power source for subsystem 1 of the PLC. |
| PMAMOD12<br>PMA0302ASA<br>PMA0302BSA<br>SUB-IDAEA2 | 2.09E-03<br>1.16E-03<br>1.16E-03<br>sub-tree | These events model failures in subsystem 2 of the division A PLC. Events PMA0302ASA and PMA0302BSA model random failures of the logic processors 2A and 2B in subsystem 2, respectively. PMAMOD12 models all other random hardware failures in subsystem 2 of the division A PLC. Sub-tree IDAEA2 models the power source for subsystem 2 of the PLC. |
| PMAXS00ASA | 8.00E-05 | This event models the I/O Bus selector, which selects between the 1B and 2B logic processor. |
| CCX-PMAMOD1<br>CCX-PMA030 | 1.41E-04<br>9.69E-05 | CCX-PMAMOD1 models common cause failures across the two subsystems of division A. CCX-PMA030 models common cause failures of the logic group processors of the PLC. |
| CCX-PMAMOD1-SW* | 1.10E-05 | This event models software common cause failures in the division A PLC. |
| SUB-EPO | sub-tree | This sub-tree models the particular output card failure for the particular actuated component. |
| CCX-EP-SAM | 8.62E-06 | This event models common cause failure of all output driver cards of the PMS system. This common cause event is common to all divisions of ESF actuation. |

| Basic Event | P(f) | Description |
|---|---|---|
| SUB-AESIPC | sub-tree | This sub-tree models the input signal logic provided by the IPC cabinet. |
| CCX-SFTW | 1.20E-06 | This common cause software event models all software failures that can affect operations in both the PMS and Plant Control System (PLS). This software common cause failure fails both the Reactor Trip and ESF functions of the PMS. |

* Note that PRA modeling in revision 7 PRA includes a sensitivity analysis on this software common cause model in which each division's software common cause failure event (CCX-PMAMOD1-SW, CCX-PMBMOD1-SW, CCX-PMCMOD1-SW, and CCX-PMDMOD1-SW) will be renamed to CCX-PMXMOD1-SW so that this software common cause event fails all trains of PLC cabinets.

Control Board Multiplexer

Fault trees MESOUT[A,B,C,D][B,P], which model the manual signals paths in the PMS, contain the following basic events that model the manual action signal multiplexer. Again, the basic events given below model the division A signal multiplexer. Other divisions are modeled the same way with the appropriate division letter designator in the place of the "A" in the PMAMOD basic events below.

| Basic Event | P(f) | Description |
|---|---|---|
| PMAMOD41 | 6.35E-04 | This basic event models subsystem 1 of the multiplexer cabinet. |
| PMAMOD42 | 6.35E-04 | This basic event models subsystem 2 of the multiplexer cabinet. |
| PMAEH0A1SA | 8.00E-05 | This basic event models the multiplexer transmitters to the PLC cabinet subsystem 1. |
| PMAEH0A2SA | 8.00E-05 | This basic event models the multiplexer transmitters to the PLC cabinet subsystem 2. |
| CCX-PMAMOD4 | 4.98E-05 | This event models common cause failures across subsystems in the multiplexer cabinet. |

| Basic Event | P(f) | Description |
|---|---|---|
| CCX-PMAEH0 | 4.03E-06 | This event models common cause failures of the multiplexer transmitters in division A. |
| CCX-PMAMOD4-SW* | 1.10E-05 | This event models software common cause failures in the multiplexer cabinet. |
| CCX-SFTW | 1.20E-06 | This common cause software event models all software failures that can affect operations in both the PMS and Plant Control System (PLS). This software common cause failure fails both the Reactor Trip and ESF functions of the PMS. |

* Note that PRA modeling in revision 7 PRA includes a sensitivity analysis on this software common cause model in which each division's software common cause failure event (CCX-PMAMOD4-SW, CCX-PMBMOD4-SW, CCX-PMCMOD4-SW, and CCX-PMDMOD4-SW) will be renamed to CCX-PMXMOD4-SW so that this software common cause event fails all trains of multiplexer cabinets.

### 6.3. DAS Reactor Trip and ESF

The diverse actuation system provides the capability to automatically or manually perform a reactor trip and selected Engineered Safety Features. In the PRA, the DAS is modeled using a black-box approach, with single nodes representing the automatic circuitry and manual circuitry. In the modeling, the only potential commonality between the DAS and the PMS or PLS systems is in the common cause failures of sensors and in external power supply assignments.

The automatic circuitry is modeled as the single basic event "DAS" in the fault trees with an unavailability of 1E-02 assigned based on the DAS unavailability design goal. This basic event includes all circuitry needed to provide automatic reactor trip or automatic ESF actuations, excluding the external power supply and sensors. The external power supply and sensors are modeled separately in the I&C subtree.

Similarly, the manual circuitry is modeled as the single basic event "MDAS" in the fault trees with an unavailability of 1E-02 assigned based on the DAS unavailability design goal. This basic event includes all circuitry needed to provide manual reactor trip or manual ESF actuations, excluding the external power supply, HRA events, and sensors. The external power supply, HRA events, and sensors are modeled separately in the I&C subtree. By system specification, the manual DAS shall be implemented by wiring the manual switches directly to the loads in a way that completely bypasses the DAS automatic logic, so no common cause failures are modeled between the automatic and manual portions of the DAS.

## 6.4. Plant Control System Functions

The Plant Control System (PLS) provides non-class 1E automatic and manual controls and indication. This system is discussed in section 7.1.3 of the AP600 SSAR. Figure 7.1-10 depicts the PLS architecture. Interface to plant loads (valves, pumps, etc.) is provided by Distributed Controllers. Section 7.1.3.1 of the SSAR discusses the distributed controllers of the PLS. Assignment of plant control functions to specific control groups is driven by plant location and function. Tables 28-12 and 28-13 show the plant functional control group assignments made in the AP600 PRA. Sensor inputs enter the system either locally through the distributed controllers or through Signal Selector Cabinets (SSCs). The SSCs receive sensor values from the communications subsystems of the PMS IPCs and provides validated process values to the PLS via the process bus. Section 7.1.3.2 of the SSAR describes the signal selectors. Interface with the main and remote shutdown control rooms is provided by the process bus multiplexers discussed in SSAR section 7.1.3.3.

The following control scenarios are modeled in the PRA:

- Automatic Control with remote (Signal Selector Cabinet- SSC) inputs
- Automatic Control with local inputs
- Manual Control

The following sub-sections discuss the modeling of the automatic control and manual control functions of the PLS.

<u>Automatic Control with Signal Selection Inputs</u>

Automatic control with signal selection inputs involves the following equipment: sensors, the communications sub-system of the PMS IPC, the signal section cabinet, the distributed controller, and the communications and support equipment. The following discusses the basic events modeling the automatic control with the signal selection inputs functions in the PLS. The APLL## fault trees model failure of automatic control of logic (on/off) signals. The APLC## fault trees model failure of the modulating control equipment. Fault trees APLIPC(B,P) model failures of the communications sub-systems of the PMS IPCs and the sensors that feed the particular control application.

For logic control, the Control Logic Cabinet (CLC) provides the interface with the plant loads. These cabinets are assumed to be similar in design to the PLC cabinets of the PMS in terms of redundancy. Fault trees APLL##(B,P) model the logic control function with SSC input. The following basic events comprise these fault tree models. The (#) symbol represents the specific control group number.

| Basic Event | P(f) | Description |
|---|---|---|
| PL#MOD11<br>SUB-ED#EA11<br>PL#0301ASA<br>PL#0301BSA | 2.09E-03<br>Sub-tree<br>1.16E-03<br>1.16E-03 | These events model failures in subsystem 1 of the control group # CLC. Events PL#0301ASA and PL#0301BSA model random failures of logic processors 1A and 1B in subsystem 1, respectively. PL#MOD11 models all other random hardware failures in subsystem 1 of the control group # CLC, including the data highway transceiver and controller, the bus, the bus monitor, internal power supply, and cabinet fan. Sub-tree ED1EA11 models the external power source for subsystem 1 of the CLC. |
| PL#MOD12<br>SUB-ED#EA2<br>PL#0302ASA<br>PL#0302BSA | 2.09E-03<br>Sub-tree<br>1.16E-03<br>1.16E-03 | These events model failures in subsystem 2 of the control group # CLC. Events PL#0302ASA and PL#0302BSA model random failures of logic processors 2A and 2B in subsystem 2, respectively. PL#MOD12 models all other random hardware failures in subsystem 2 of the control group # CLC, including the data highway transceiver and controller, the bus, the bus monitor, internal power supply, and cabinet fan. Sub-tree ED1EA2 models the external power source for subsystem 1 of the CLC. |
| PL#XS00ASA | 8.00E-05 | This event models the I/O Bus selector, which selects between the 1B and 2B logic processor. |
| CCX-PL#MOD1 | 1.41E-04 | This event models common cause failures across the subsystems of control logic group #. |
| CCX-PL#MOD1-SW | 1.10E-05 | This event models common cause failure of the software modules of control logic group #. |
| CCX-PL#03 | 9.69E-05 | This event models common cause failure of the logic processors of the control logic group #. |
| SUB-EPO | Sub-tree | This sub-tree models the random hardware failures of the output driver module specific to the actuated component. |

| Basic Event | P(f) | Description |
|---|---|---|
| CCX-EP-SA | 8.62E-06 | This basic event models common cause failure of all logic output driver modules in the PLS. |
| CCX-PL#EH0 | 4.03E-06 | This basic event models common cause failure of the communications devices in control group #. |
| PLSMOD61<br>PLSMOD62 | 3.46E-03<br>3.46E-03 | These events model the random hardware failures of sub-systems 1 and 2 of the signal selector. This signal selector is common to all PLS functions requiring signal selector input in the AP600 PRA. |
| CCX-PLSMOD6 | 2.53E-04 | This event models common cause failure of the two sub-systems of the signal selector. |
| CCX-PLSMOD6-SW | 1.10E-05 | This event models common cause failure of the software of the signal selector. |
| SUB-APLIPC | Sub-tree | This sub-tree models failures of the communications subsystems and sensors of the PMS IPCs. |
| CCX-SFTW | 1.20E-06 | This common cause software event models all software failures that can affect operations in both the PMS and Plant Control System (PLS). This software common cause failure fails both the Reactor Trip and ESF functions of the PMS. |

For modulating control, the Integrated Control Cabinet (ICC) provides the interface with the plant loads. Fault trees APLC##(B,P) model the modulating control function with SSC input. The following basic events comprise these fault tree models. The (#) symbol represents the specific control group number.

| Basic Event | P(f) | Description |
|---|---|---|
| PL#MOD51<br>SUB-ED#EA11 | 8.74E-04<br>Sub-tree | These events model failures in subsystem 1 of the control group # ICC. PL#MOD51 models all other random hardware failures in subsystem 1 of the control group # ICC, including the processor, data highway transceiver and controller, the bus, the bus monitor, internal power supply, and cabinet fan. Sub-tree ED2EA11 models the external power source for subsystem 1 of the ICC. |
| PL#MOD52<br>SUB-ED#EA2 | 8.74E-04<br>Sub-tree | These events model failures in subsystem 2 of the control group # ICC. PL#MOD52 models all other random hardware failures in subsystem 2 of the control group # ICC, including the processor, data highway transceiver and controller, the bus, the bus monitor, internal power supply, and cabinet fan. Sub-tree ED2EA2 models the external power source for subsystem 2 of the ICC. |
| CCX-PL#MOD5 | 6.98E-05 | This event models common cause failures across the subsystems of the ICC group #. |
| CCX-PL#MOD5-SW | 1.10E-05 | This event models common cause failure of the software modules of integrated control group #. |
| SUB-EAO1<br>SUB-EAO2 | Sub-tree | These sub-trees model the random hardware failures of the active-standby redundant modulating output driver modules specific to the actuated component. |
| CCX-EAO | 3.23E-06 | This basic event models common cause failure of all modulating output driver modules in the PLS. |
| PLSMOD61<br>PLSMOD62 | 3.46E-03<br>3.46E-03 | These events model the random hardware failures of sub-systems 1 and 2 of the signal selector. This signal selector is common to all PLS functions requiring signal selector input in the AP600 PRA. |
| CCX-PLSMOD6 | 2.53E-04 | This event models common cause failure of the two sub-systems of the signal selector. |

| Basic Event | P(f) | Description |
|---|---|---|
| CCX-PLSMOD6-SW | 1.10E-05 | This event models common cause failure of the software of the signal selector. |
| SUB-APLIPC | Sub-tree | This sub-tree models failures of the communications subsystems and sensors of the PMS IPCs. |
| CCX-SFTW | 1.20E-06 | This common cause software event models all software failures that can affect operations in both the PMS and Plant Control System (PLS). This software common cause failure fails both the Reactor Trip and ESF functions of the PMS. |

The sub-tree APLIPC(B,P) models the failures of the PMS IPC communications sub-systems that communicate sensor values to the signal selectors of the PLS. The basic events that model the failures of the communications sub-systems of the PMS IPCs are as follows:

| Basic Event | P(f) | Description |
|---|---|---|
| PLAMOD31<br>SUB-IDAEA1<br>SUB-SENS1 | 5.02E-03 not including sub-trees | Division A IPC communications subsystem random hardware failures. Sub-tree IDAEA1 models the class 1E power to the subsystem. Sub-tree SENS1 models the particular sensor random failures that provide inputs to the division A communication subsystem. |
| PLBMOD32<br>SUB-IDBEA3<br>SUB-SENS2 | 5.02E-03 not including sub-trees | Division B IPC communications subsystem random hardware failures. |
| PLCMOD33<br>SUB-IDCEA3<br>SUB-SENS3 | 5.02E-03 not including sub-trees | Division C IPC communications subsystem random hardware failures. |
| PLDMOD34<br>SUB-IDDEA1<br>SUB-SENS4 | 5.02E-03 not including sub-trees | Division D IPC communications subsystem random hardware failures. |
| CCX-PLMOD3 | 1.03E-04 | Common cause failure of the hardware portions of the communications sub-system input circuitry. |

| Basic Event | P(f) | Description |
|---|---|---|
| CCX-PLMOD3-SW | 1.10E-05 | Common cause failure of the software portions of the communications sub-system input function. |
| SUB-CCXSNRS1 | sub-tree | Sub-tree that models the sensor common cause failures for the PLS function modeled. |
| CCX-SFTW | 1.20E-06 | This common cause software event models all software failures that can affect operations in both the PMS and Plant Control System (PLS). This software common cause failure fails both the Reactor Trip and ESF functions of the PMS. |

Automatic Control with Local Inputs

Automatic control with local inputs involves the following equipment: sensors, the distributed controllers, and the communications and support equipment. The following discusses the basic events that model the automatic control with local inputs function of the PLS.

The AP600 PRA assumes that all local sensor inputs enter the system via the Integrated Control Cabinets (ICCs). The PRA also assumes that all modulating controls are provided by the Integrated Control Cabinets (ICCs), and all logic (on/off) controls are provided by the Control Logic Cabinets (CLCs). The APLLL## fault trees model failure of automatic control of logic (on/off) signals with local sensor input. The APLCC## fault trees model failure of the modulating control equipment and the local sensor input circuitry for the logic control function.

For logic control, the Control Logic Cabinet (CLC) provides the interface with the plant loads. Fault trees APLLL##(B,P) model the logic control function with local inputs. The following basic events comprise these fault tree models. The (#) symbol represents the specific control group number.

| Basic Event | P(f) | Description |
|---|---|---|
| PL#MOD11<br>SUB-ED#EA11<br>PL#0301ASA<br>PL#0301BSA | 2.09E-03<br>Sub-tree<br>1.16E-03<br>1.16E-03 | Same as those basic events discussed for the logic control with SSC inputs above. |
| PL#MOD12<br>SUB-ED#EA2<br>PL#0302ASA<br>PL#0302BSA | 2.09E-03<br>Sub-tree<br>1.16E-03<br>1.16E-03 | |
| PL#XS00ASA | 8.00E-05 | |
| CCX-PL#MOD1 | 1.41E-04 | |
| CCX-PL#MOD1-SW | 1.10E-05 | |
| CCX-PL#03 | 9.69E-05 | |
| SUB-EPO | Sub-tree | |
| CCX-EP-SA | 8.62E-06 | |
| CCX-SFTW | 1.20E-06 | |
| SUB-EPI | Sub-tree | This sub-tree models a digital input module for input signals to the CLC. In the AP600 PRA, there are no inputs directly to the CLC modeled. All local inputs to the PLS enter the system via the ICCs. |
| CCX-EPI | 1.00E-10 | This event models common cause failure of all input modules to the CLCs. Since no inputs to the CLCs are modeled in the AP600 PRA, a very low probability is assigned for this basic event. |
| SUB-PLSENSOR | Sub-tree | This sub-tree models failures of the sensors for the particular PLS control function modeled. |

For modulating control, the Integrated Control Cabinet (ICC) provides the interface with the plant loads. The AP600 PRA also models the ICC as the source for all local inputs to the PLS. Fault trees APLCC##(B,P) model the modulating control function and local sensor input function for the PLS. The following basic events comprise these fault tree models. The (#) symbol represents the specific control group number.

| Basic Event | P(f) | Description |
|---|---|---|
| PL#MOD51<br>SUB-ED#EA11 | 8.74E-04<br>Sub-tree | Same as the ICC with SSC input function. |
| PL#MOD52<br>SUB-ED#EA2 | 8.74E-04<br>Sub-tree | |
| CCX-PL#MOD5 | 6.98E-05 | |
| CCX-PL#MOD5-SW | 1.10E-05 | |
| SUB-EAO1<br>SUB-EAO2 | Sub-tree | |
| CCX-EAO | 3.23E-06 | |
| CCX-SFTW | 1.20E-06 | |
| SUB-EAI1<br>SUB-EAI2 | Sub-trees | These events model the random hardware failures of the active-standby redundant analog input modules for the input signals modeled. |
| CCX-EAI | 1.27E-05 | This event models common cause failure of all analog input modules in the PLS. |
| SUB-PLSENSOR | Sub-tree | This sub-tree models failures of the local sensors modeled for the particular PLS function modeled. |

Manual Control

The PLS manual control function involves the following equipment: indications, the control room multiplexers, distributed controllers, and the communications and support equipment. The following discusses the basic events that model the manual control function of the PLS.

For manual logic control, the Control Logic Cabinet (CLC) provides the interface with the plant loads. Fault trees MPLL##(B,P) model the logic control function with manual inputs. The following basic events comprise these fault tree models. The (#) symbol represents the specific control group number.

| Basic Event | P(f) | Description |
|---|---|---|
| PL#MOD11<br>SUB-ED#EA11<br>PL#0301ASA<br>PL#0301BSA | 2.09E-03<br>Sub-tree<br>1.16E-03<br>1.16E-03 | Same as those basic events discussed for the logic control with SSC inputs above. |
| PL#MOD12<br>SUB-ED#EA2<br>PL#0302ASA<br>PL#0302BSA | 2.09E-03<br>Sub-tree<br>1.16E-03<br>1.16E-03 | |
| PL#XS00ASA | 8.00E-05 | |
| CCX-PL#MOD1 | 1.41E-04 | |
| CCX-PL#MOD1-SW | 1.10E-05 | |
| CCX-PL#03 | 9.69E-05 | |
| SUB-EPO | Sub-tree | |
| CCX-EP-SA | 8.62E-06 | |
| CCX-SFTW | 1.20E-06 | |
| ALL-IND-FAIL | 1.00E-06 | Failure of all sources of indication to the operator. |
| SUB-CCXSNRS2 | Sub-tree | Sub-tree that models the common cause failure of the sensors that provide the operator with the necessary cues. |
| SUB-ESFOPER | Sub-tree | Sub-tree that models the reliability of the operator to perform the action required. |
| PLMMOD41<br>PLMMOD42 | 6.35E-04<br>6.35E-04 | These basic events model failure of sub-systems 1 and 2 of the control board multiplexer. Only one dual-redundant control board multiplexer is modeled in the PLS. |
| CCX-PLMMOD4 | 4.98E-05 | This basic event models the hardware common cause failure of both sub-systems of the control board multiplexer. |
| CCX-PLMMOD4-SW | 1.10E-05 | This basic event models the software common cause failure of the control board multiplexer. |
| PL#EH0A1SA<br>PL#EH0A2SA | 8.00E-05<br>8.00E-05 | These basic events model failure of the multiplexing transmitters that communicate to group # controllers. |

| Basic Event | P(f) | Description |
|---|---|---|
| CCX-PL1EH0 | 4.03E-06 | This basic event models common cause failure of the multiplexing transmitters. |

For manual modulating control, the Integrated Control Cabinet (ICC) provides the interface with the plant loads. The AP600 PRA also models the ICC as the source for all local inputs to the PLS. Fault trees MPLC##(B,P) model the manual modulating control function for the PLS. The following basic events comprise these fault tree models. The (#) symbol represents the specific control group number.

| Basic Event | P(f) | Description |
|---|---|---|
| PL#MOD51<br>SUB-ED#EA11 | 8.74E-04<br>Sub-tree | Same as the ICC with SSC input function. |
| PL#MOD52<br>SUB-ED#EA2 | 8.74E-04<br>Sub-tree | |
| CCX-PL#MOD5 | 6.98E-05 | |
| CCX-PL#MOD5-SW | 1.10E-05 | |
| SUB-EAO1<br>SUB-EAO2 | Sub-tree | |
| CCX-EAO | 3.23E-06 | |
| CCX-SFTW | 1.20E-06 | |
| ALL-IND-FAIL | 1.00E-06 | Failure of all sources of indication to the operator. |
| SUB-CCXSNRS2 | Sub-tree | Sub-tree that models the common cause failure of the sensors that provide the operator with the necessary cues. |
| SUB-ESFOPER | Sub-tree | Sub-tree that models the reliability of the operator to perform the action required. |
| PLMMOD41<br>PLMMOD42 | 6.3500E-04<br>6.3500E-04 | These basic events model failure of sub-systems 1 and 2 of the control board multiplexer. Only one dual-redundant control board multiplexer is modeled in the PLS. |

| Basic Event | P(f) | Description |
|---|---|---|
| CCX-PLMMOD4 | 4.9800E-05 | This basic event models the hardware common cause failure of both sub-systems of the control board multiplexer. |
| CCX-PLMMOD4-SW | 1.1000E-05 | This basic event models the software common cause failure of the control board multiplexer. |
| PL#EH0A1SA<br>PL#EH0A2SA | 8.0000E-05<br>8.0000E-05 | These basic events model failure of the multiplexing transmitters that communicate to group # controllers. |
| CCX-PL1EH0 | 4.0300E-06 | This basic event models common cause failure of the multiplexing transmitters. |

## 7. I&C Modeling Results

All of the results below include full credit to the electric power systems since these cases yield the most optimistic results. Cases in which the power systems are not fully functional (Loss of Offsite Power and Station Blackout) yield more conservative results. The results given exclude the unavailability of sensors and the unreliability of the operator, since these values vary. Therefore, the results presented below give the upper bounding estimates of reliability claims for the I&C systems in the AP600 PRA. Combining the results below give an approximation of the credit given to the I&C system for functions that are applied to multiple systems.

### 7.1 Protection and Safety Monitoring System (PMS) Reactor Protection System Results

Automatic Reactor Protection System Trip

The automatic reactor trip function unavailability is assessed to be 8.8E-05. This assessment is dominated by common cause failure of the automatic reactor trip system hardware (CCX-PMS-HARDWARE), which has an assessed unavailability of 7.9E-05. Other contributors are common cause failure of the reactor trip breakers (RCX-RB-FA) at 8.1E-06, common cause failure of software (CCX-SFTW) at 1.2E-06, and common cause failure of multiple sensor types (CCX-PMS-SENSORS) at 4.0E-08.

Manual Reactor Protection System Trip

The manual reactor protection system trip result is dominated by the unreliability of the operator. The hardware used to trip the reactor manually has an assessed unavailability of 3.8E-05. This unavailability accounts for both the manual switches and reactor trip switchgear.

Automatic and Manual Reactor Protection System Trip

When the automatic and manual reactor trip functions are logically ANDed together, the resultant unavailability of the reactor trip function is 1.2E-05, which is dominated by failure of the reactor trip breakers (8.1E-06).

## 7.2 Protection and Safety Monitoring System (PMS) Engineered Safety Features (ESF) Results

Automatic ESF Actuations

Results

| | |
|---|---|
| - Single auto actuation signal | 1E-03 + Sensors |
| - Multiple auto actuations within a division | 8E-04 + Sensors |
| - Multiple auto actuations across divisions | 1E-04 + Sensors |

Manual ESF Actuations

Results

| | |
|---|---|
| - Single manual actuation signal | 6E-04 + Operator Action + Sensors |
| - Multiple manual actuations within a division | 5E-04 + Operator Action + Sensors |
| - Multiple manual actuations across divisions | 1E-05 + Operator Action + Sensors |

The manual actuation models are dominated by the operator action unreliability models which are included in the I&C subtrees as described in section 26.4.3 of the PRA.

Automatic and Manual Actuations

Results

| | |
|---|---|
| - Auto and manual actuations within a division | 5E-04 + Operator Action + Sensors |
| - Auto and manual actuations across divisions | 1E-05 + Operator Action + Sensors |

Common between the automatic actuation models and manual actuation models are software common cause failure (CCX-SFTW), the protection logic cabinet (PLC) failures, and potentially sensor failures.

## 7.3 Diverse Actuation System Results

Results

| | |
|---|---|
| - Automatic DAS actuation (reactor trip or ESF) | 1E-02 + Sensors |
| - Manual DAS actuation (reactor trip or ESF) | 1E-02 + Operator Action + Sensors |

## 7.4 Plant Control System Results

Automatic Control

Results

| | |
|---|---|
| - Single auto control signal within a control group | 8E-04 + Sensors |
| - Multiple auto control signals within a control group | 6E-04 + Sensors |
| - Multiple auto control signals across control groups | 5E-04 + Sensors |

Manual Control

Results

| | |
|---|---|
| - Single manual control signal within a control group | 5E-04 + Operator Action + Sensors |
| - Multiple manual control signals within a control group | 4E-04 + Operator Action + Sensors |
| - Multiple manual control signals across a control group | 1E-04 + Operator Action + Sensors |

Automatic and Manual Control

Results

| | |
|---|---|
| - Auto and manual control within a control group | 4E-04 + Operator Action + Sensors |
| - Auto and manual control across control groups | 1E-04 + Operator Action + Sensors |

Re: PRA I&C modeling question from NRC letter dated January 22, 1996

Question 720.308 (#3039)

The staff was unable to find in the revised PRA submittal the unavailabilities for the various PMS and PLS I&C subtrees. This information is needed for efficient review of the I&C PRA models. Please provide this information. In addition, please provide lists of the top 200 cutsets for IC11A (line 1 of ADS stage #1 fails to open) and IC12A (line 2 of ADS stage #1 fails to open).

Response:

The cutsets for I&C fault tree models IC11A (line 1 of ADS stage #1 fails to open) and IC12A (line 2 of ADS stage #1 fails to open), along with unavailability results for each I&C subtree are provided in Attachment A to this RAI response.

Attachment A to RAI 720.308 Response
(AP600 PRA I&C RAIs)

## Table A-1

Cutsets for the IC11A Fault tree Model

```
VER 1.6
 File created by linking ic11a.wlk       WLINK ** Ver. 3.11 **
   72     479  1.488E-05   .00    1.00E-10
```

| | | | |
|---|---|---|---|
| 1 | ADAEP001ASA | 1.7100E-04 | .0000E+00 |
| 2 | ADAEP011ASA | 1.7100E-06 | .0000E+00 |
| 3 | AND-MAN01 | 4.9300E-04 | .0000E+00 |
| 4 | ALL-IND-FAIL | 1.0000E-06 | .0000E+00 |
| 5 | CCX-BY-PW | 4.7000E-05 | .0000E+00 |
| 6 | CCX-BY-PW1 | 5.7600E-05 | .0000E+00 |
| 7 | CCX-EP-SAM | 8.6200E-06 | .0000E+00 |
| 8 | CCX-IN-LOGIC-SW | 1.1000E-05 | .0000E+00 |
| 9 | CCX-INPUT-LOGIC | 1.0300E-04 | .0000E+00 |
| 10 | CCX-IV-XR | 2.6000E-05 | .0000E+00 |
| 11 | CCX-IV-XR1 | 2.6000E-05 | .0000E+00 |
| 12 | CCX-PMA030 | 9.6900E-05 | .0000E+00 |
| 13 | CCX-PMAMOD1 | 1.4100E-04 | .0000E+00 |
| 14 | CCX-PMAMOD1-SW | 1.1000E-05 | .0000E+00 |
| 15 | CCX-PMAMOD2 | 3.0400E-04 | .0000E+00 |
| 16 | CCX-PMAMOD2-SW | 1.1000E-05 | .0000E+00 |
| 17 | CCX-PMAMOD4 | 4.9800E-05 | .0000E+00 |
| 18 | CCX-SFTW | 1.2000E-06 | .0000E+00 |
| 19 | CCX-XMTR | 2.0100E-04 | .0000E+00 |
| 20 | CMX-VS-FA | 3.8400E-05 | .0000E+00 |
| 21 | DUMMY | 1.0000E-10 | .0000E+00 |
| 22 | EC0MOD01 | 1.3100E-02 | .0000E+00 |
| 23 | EC1BS001LF | 4.8000E-06 | .0000E+00 |
| 24 | EC1BS001TM | 2.7000E-03 | .0000E+00 |
| 25 | EC1BS011TM | 2.7000E-03 | .0000E+00 |
| 26 | EC1BS012TM | 2.7000E-03 | .0000E+00 |
| 27 | EC1BS111TM | 2.7000E-03 | .0000E+00 |
| 28 | EC1BS121TM | 2.7000E-03 | .0000E+00 |
| 29 | EC1CB100VO | 1.2300E-02 | .0000E+00 |
| 30 | EC1MOD12 | 4.8000E-05 | .0000E+00 |
| 31 | EC1MOD121 | 1.6800E-05 | .0000E+00 |
| 32 | EC2BS002TM | 2.7000E-03 | .0000E+00 |
| 33 | EC2BS023TM | 2.7000E-03 | .0000E+00 |
| 34 | ECX-CB-GC | 7.3000E-04 | .0000E+00 |
| 35 | ECX-CB-GO | 1.2000E-03 | .0000E+00 |
| 36 | ED1MOD03 | 2.7000E-03 | .0000E+00 |
| 37 | ED1MOD11 | 3.1700E-04 | .0000E+00 |
| 38 | ED1MOD113 | 3.1700E-04 | .0000E+00 |
| 39 | ED3BSDS1TM | 3.0000E-04 | .0000E+00 |
| 40 | ED3MOD01 | 5.0400E-04 | .0000E+00 |
| 41 | ED3MOD03 | 2.7000E-03 | .0000E+00 |
| 42 | ED3MOD04 | 2.1900E-02 | .0000E+00 |
| 43 | ED3MOD07 | 3.0500E-04 | .0000E+00 |
| 44 | ED4BSDS1TM | 3.0000E-04 | .0000E+00 |
| 45 | ED4MOD11 | 3.1700E-04 | .0000E+00 |
| 46 | ED4MOD112 | 3.1700E-04 | .0000E+00 |
| 47 | IDABSDS1LF | 4.8000E-06 | .0000E+00 |

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| 48 | IDABSDS1TM | 3.0000E-04 | .0000E+00 |
| 49 | IDAMOD02 | 2.7000E-03 | .0000E+00 |
| 50 | IDAMOD03 | 2.7000E-03 | .0000E+00 |
| 51 | IDAMOD04 | 3.1700E-04 | .0000E+00 |
| 52 | IDAMOD05 | 5.1600E-04 | .0000E+00 |
| 53 | IDAMOD06 | 4.3200E-05 | .0000E+00 |
| 54 | IDAMOD07 | 2.1900E-02 | .0000E+00 |
| 55 | IDAMOD08 | 3.1700E-04 | .0000E+00 |
| 56 | LPM-MAN03 | 2.2000E-03 | .0000E+00 |
| 57 | MDAS | 1.0000E-02 | .0000E+00 |
| 58 | PMA0301ASA | 1.1600E-03 | .0000E+00 |
| 59 | PMA0301BSA | 1.1600E-03 | .0000E+00 |
| 60 | PMA0302ASA | 1.1600E-03 | .0000E+00 |
| 61 | PMA0302BSA | 1.1600E-03 | .0000E+00 |
| 62 | PMAMOD11 | 2.0900E-03 | .0000E+00 |
| 63 | PMAMOD12 | 2.0900E-03 | .0000E+00 |
| 64 | PMAMOD21 | 4.0700E-03 | .0000E+00 |
| 65 | PMAMOD22 | 4.0700E-03 | .0000E+00 |
| 66 | PMAXSC0ASA | 8.0000E-05 | .0000E+00 |
| 67 | REC-MANDAS | 1.1600E-02 | .0000E+00 |
| 68 | ZO1DG001TM | 4.6000E-02 | .0000E+00 |
| 69 | ZO1MOD01 | 2.0200E-02 | .0000E+00 |
| 70 | ZO1MOD04 | 1.2500E-03 | .0000E+00 |
| 71 | ZOX-DG-DR | 4.4000E-04 | .0000E+00 |
| 72 | ZOX-PD-ES | 2.0000E-03 | .0000E+00 |

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| 1. | 1.98E-06 | 2 | REC-MANDAS | ADAEP011ASA | |
| 2. | 1.98E-06 | 2 | REC-MANDAS | ADAEP001ASA | |
| 3. | 1.71E-06 | 2 | MDAS | ADAEP011ASA | |
| 4. | 1.71E-06 | 2 | MDAS | ADAEP001ASA | |
| 5. | 1.64E-06 | 2 | REC-MANDAS | CCX-PMAMOD1 | |
| 6. | 1.41E-06 | 2 | MDAS | CCX-PMAMOD1 | |
| 7. | 1.12E-06 | 2 | REC-MANDAS | CCX-PMA030 | |
| 8. | 9.69E-07 | 2 | MDAS | CCX-PMA030 | |
| 9. | 1.28E-07 | 2 | REC-MANDAS | CCX-PMAMOD1-SW | |
| 10. | 1.10E-07 | 2 | MDAS | CCX-PMAMOD1-SW | |
| 11. | 1.00E-07 | 2 | REC-MANDAS | CCX-EP-SAM | |
| 12. | 8.62E-08 | 2 | MDAS | CCX-EP-SAM | |
| 13. | 6.55E-08 | 3 | REC-MANDAS | PMAMOD11 | EC1BS001TM |
| 14. | 6.55E-08 | 3 | REC-MANDAS | PMAMOD11 | EC1BS012TM |
| 15. | 6.55E-08 | 3 | REC-MANDAS | PMAMOD11 | EC1BS121TM |
| 16. | 5.64E-08 | 3 | MDAS | PMAMOD11 | EC1BS001TM |
| 17. | 5.64E-08 | 3 | MDAS | PMAMOD11 | EC1BS012TM |
| 18. | 5.64E-08 | 3 | MDAS | PMAMOD11 | EC1BS121TM |
| 19. | 5.22E-08 | 2 | ADAEP011ASA | ED3MOD07 | |
| 20. | 5.22E-08 | 2 | ADAEP001ASA | ED3MOD07 | |
| 21. | 5.07E-08 | 3 | REC-MANDAS | PMAMOD11 | PMAMOD12 |
| 22. | 4.37E-08 | 3 | MDAS | PMAMOD11 | PMAMOD12 |
| 23. | 6.30E-08 | 2 | CCX-PMAMOD1 | ED3MOD07 | |
| 24. | 3.63E-08 | 3 | REC-MANDAS | PMA0301ASA | EC1BS001TM |
| 25. | 3.63E-08 | 3 | REC-MANDAS | PMA0301ASA | EC1BS012TM |
| 26. | 3.63E-08 | 3 | REC-MANDAS | PMA0301ASA | EC1BS121TM |
| 27. | 3.63E-08 | 3 | REC-MANDAS | PMA0301BSA | EC1BS001TM |
| 28. | 3.63E-08 | 3 | REC-MANDAS | PMA0301BSA | EC1BS012TM |
| 29. | 3.63E-08 | 3 | REC-MANDAS | PMA0301BSA | EC1BS121TM |
| 30. | 3.13E-08 | 3 | MDAS | PMA0301ASA | EC1BS001TM |

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| 31. | 3.13E-08 | 3 | MDAS | PMA0301ASA | EC1BS012TM | |
| 32. | 3.13E-08 | 3 | MDAS | PMA0301ASA | EC1BS121TM | |
| 33. | 3.13E-08 | 3 | MDAS | PMA0301BSA | EC1BS001TM | |
| 34. | 3.13E-08 | 3 | MDAS | PMA0301BSA | EC1BS012TM | |
| 35. | 3.13E-08 | 3 | MDAS | PMA0301BSA | EC1BS121TM | |
| 36. | 2.96E-08 | 2 | CCX-PMA030 | ED3MOD07 | | |
| 37. | 2.81E-08 | 3 | REC-MANDAS | PMAMOD12 | PMA0301ASA | |
| 38. | 2.81E-08 | 3 | REC-MANDAS | PMAMOD11 | PMA0302ASA | |
| 39. | 2.81E-08 | 3 | REC-MANDAS | PMA0301BSA | PMAMOD12 | |
| 40. | 2.81E-08 | 3 | REC-MANDAS | PMAMOD11 | PMA0302BSA | |
| 41. | 2.42E-08 | 3 | MDAS | PMAMOD12 | PMA0301ASA | |
| 42. | 2.42E-08 | 3 | MDAS | PMAMOD11 | PMA0302ASA | |
| 43. | 2.42E-08 | 3 | MDAS | PMA0301BSA | PMAMOD12 | |
| 44. | 2.42E-08 | 3 | MDAS | PMAMOD11 | PMA0302BSA | |
| 45. | 1.62E-08 | 3 | REC-MANDAS | IDAMOD05 | EC1BS001TM | |
| 46. | 1.62E-08 | 3 | REC-MANDAS | IDAMOD05 | EC1BS012TM | |
| 47. | 1.62E-08 | 3 | REC-MANDAS | IDAMOD05 | EC1BS121TM | |
| 48. | 1.56E-08 | 3 | REC-MANDAS | PMA0301ASA | PMA0302ASA | |
| 49. | 1.52E-08 | 3 | PMAMOD11 | EC1BS001TM | ED3MOD03 | |
| 50. | 1.46E-08 | 4 | REC-MANDAS | PMAMOD11 | ZO1DG001TM | EC0MOD01 |
| 51. | 1.39E-08 | 3 | MDAS | IDAMOD05 | EC1BS001TM | |
| 52. | 1.39E-08 | 3 | MDAS | IDAMOD05 | EC1BS012TM | |
| 53. | 1.39E-08 | 3 | MDAS | IDAMOD05 | EC1BS121TM | |
| 54. | 1.39E-08 | 2 | CCX-SFTW | REC-MANDAS | | |
| 55. | 1.35E-08 | 3 | MDAS | PMA0301ASA | PMA030[illegible]ASA | |
| 56. | 1.26E-08 | 4 | MDAS | PMAMOD11 | ZO1DG001TM | EC0MOD01 |
| 57. | 1.20E-08 | 2 | CCX-SFTW | MDAS | | |
| 58. | 9.93E-09 | 3 | REC-MANDAS | IDAMOD04 | EC1BS001TM | |
| 59. | 9.93E-09 | 3 | REC-MANDAS | IDAMOD04 | EC1BS012TM | |
| 60. | 9.93E-09 | 3 | REC-MANDAS | IDAMOD04 | EC1BS121TM | |
| 61. | 9.40E-09 | 3 | REC-MANDAS | IDABSDS1TM | EC1BS001TM | |
| 62. | 9.40E-09 | 3 | REC-MANDAS | IDABSDS1TM | EC1BS012TM | |
| 63. | 9.40E-09 | 3 | REC-MANDAS | IDABSDS1TM | EC1BS121TM | |
| 64. | 8.56E-09 | 3 | MDAS | IDAMOD04 | EC1BS001TM | |
| 65. | 8.56E-09 | 3 | MDAS | IDAMOD04 | EC1BS012TM | |
| 66. | 8.56E-09 | 3 | MDAS | IDAMOD04 | EC1BS121TM | |
| 67. | 8.46E-09 | 3 | PMA0301ASA | EC1BS001TM | ED3MOD03 | |
| 68. | 8.46E-09 | 3 | PMA0301BSA | EC1BS001TM | ED3MOD03 | |
| 69. | 8.11E-09 | 4 | REC-MANDAS | PMA0301ASA | ZO1DG001TM | EC0MOD01 |
| 70. | 8.11E-09 | 4 | REC-MANDAS | PMA0301BSA | ZO1DG001TM | EC0MOD01 |
| 71. | 8.10E-09 | 3 | MDAS | IDABSDS1TM | EC1BS001TM | |
| 72. | 8.10E-09 | 3 | MDAS | IDABSDS1TM | EC1BS012TM | |
| 73. | 8.10E-09 | 3 | MDAS | IDABSDS1TM | EC1BS121TM | |
| 74. | 7.76E-09 | 3 | REC-MANDAS | CCX-PMAMOD2 | LPM-MAN03 | |
| 75. | 7.72E-09 | 2 | CMX-VS-FA | CCX-XMTR | | |
| 76. | 7.69E-09 | 3 | REC-MANDAS | PMAMOD12 | IDAMOD04 | |
| 77. | 7.69E-09 | 3 | REC-MANDAS | PMAMOD11 | IDAMOD08 | |
| 78. | 6.99E-09 | 4 | MDAS | PMA0301ASA | ZO1DG001TM | EC0MOD01 |
| 79. | 6.99E-09 | 4 | MDAS | PMA0301BSA | ZO1DG001TM | EC0MOD01 |
| 80. | 6.69E-09 | 3 | MDAS | CCX-PMAMOD2 | LPM-MAN03 | |
| 81. | 6.63E-09 | 3 | MDAS | PMAMOD12 | IDAMOD04 | |
| 82. | 6.63E-09 | 3 | MDAS | PMAMOD11 | IDAMOD08 | |
| 83. | 6.42E-09 | 4 | REC-MANDAS | PMAMOD11 | ZO1MOD01 | EC0MOD01 |
| 84. | 5.53E-09 | 4 | MDAS | PMAMOD11 | ZO1MOD01 | EC0MOD01 |
| 85. | 4.27E-09 | 3 | REC-MANDAS | PMA0301ASA | IDAMOD08 | |

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| 86. | 4.27E-09 | 3 | REC-MANDAS | PMA0302ASA | IDAMOD04 | |
| 87. | 4.27E-09 | 3 | REC-MANDAS | PMA0301BSA | IDAMOD08 | |
| 88. | 4.27E-09 | 3 | REC-MANDAS | PMA0302BSA | IDAMOD04 | |
| 89. | 3.91E-09 | 4 | REC-MANDAS | PMAMOD11 | EC1CB100VO | EC0MOD01 |
| 90. | 3.76E-09 | 3 | IDAMOD05 | EC1BS001TM | ED3MOD03 | |
| 91. | 3.68E-09 | 3 | MDAS | PMA0301ASA | IDAMOD08 | |
| 92. | 3.68E-09 | 3 | MDAS | PMA0302ASA | IDAMOD04 | |
| 93. | 3.68E-09 | 3 | MDAS | PMA0301BSA | IDAMOD08 | |
| 94. | 3.68E-09 | 3 | MDAS | PMA0302BSA | IDAMOD04 | |
| 95. | 3.61E-09 | 4 | REC-MANDAS | IDAMOD05 | ZO1DG001TM | EC0MOD01 |
| 96. | 3.56E-09 | 4 | REC-MANDAS | PMA0301ASA | ZO1MOD01 | EC0MOD01 |
| 97. | 3.56E-09 | 4 | REC-MANDAS | PMA0301BSA | ZO1MOD01 | EC0MOD01 |
| 98. | 3.40E-09 | 4 | PMAMOD11 | ZO1DG001TM | EC0MOD01 | ED3MOD03 |
| 99. | 3.37E-09 | 4 | MDAS | PMAMOD11 | EC1CB100VO | EC0MOD01 |
| 100. | 3.36E-09 | 2 | CCX-PMAMOD1-SW | ED3MOD07 | | |
| 101. | 3.11E-09 | 4 | MDAS | IDAMOD05 | ZO1DG001TM | EC0MOD01 |
| 102. | 3.07E-09 | 4 | MDAS | PMA0301ASA | ZO1MOD01 | EC0MOD01 |
| 103. | 3.07E-09 | 4 | MDAS | PMA0301BSA | ZO1MOD01 | EC0MOD01 |
| 104. | 2.84E-09 | 3 | PMAMOD11 | EC1BS001TM | ED3MOD01 | |
| 105. | 2.63E-09 | 2 | CCX-EP-SAM | ED3MOD07 | | |
| 106. | 2.63E-09 | 3 | REC-MANDAS | CCX-INPUT-LOGIC | LPM-MAN03 | |
| 107. | 2.51E-09 | 3 | REC-MANDAS | PMAXS00ASA | EC1BS001TM | |
| 108. | 2.51E-09 | 3 | REC-MANDAS | PMAXS00ASA | EC1BS012TM | |
| 109. | 2.51E-09 | 3 | REC-MANDAS | PMAXS00ASA | EC1BS121TM | |
| 110. | 2.31E-09 | 3 | IDAMOD04 | EC1BS001TM | ED3MOD03 | |
| 111. | 2.27E-09 | 3 | MDAS | CCX-INPUT-LOGIC | LPM-MAN03 | |
| 112. | 2.22E-09 | 4 | REC-MANDAS | IDAMOD04 | ZO1DG001TM | EC0MOD01 |
| 113. | 2.19E-09 | 3 | IDABSDS1TM | EC1BS001TM | ED3MOD03 | |
| 114. | 2.17E-09 | 4 | REC-MANDAS | PMA0301ASA | EC1CB100VO | EC0MOD01 |
| 115. | 2.17E-09 | 4 | REC-MANDAS | PMA0301BSA | EC1CB100VO | EC0MOD01 |
| 116. | 2.16E-09 | 3 | MDAS | PMAXS00ASA | EC1BS001TM | |
| 117. | 2.16E-09 | 3 | MDAS | PMAXS00ASA | EC1BS012TM | |
| 118. | 2.16E-09 | 3 | MDAS | PMAXS00ASA | EC1BS121TM | |
| 119. | 2.10E-09 | 4 | REC-MANDAS | IDABSDS1TM | ZO1DG001TM | EC0MOD01 |
| 120. | 1.94E-09 | 3 | REC-MANDAS | PMAXS00ASA | PMAMOD12 | |
| 121. | 1.94E-09 | 3 | REC-MANDAS | PMAXS00ASA | PMAMOD11 | |
| 122. | 1.91E-09 | 4 | MDAS | IDAMOD04 | ZO1DG001TM | EC0MOD01 |
| 123. | 1.89E-09 | 3 | ADAEP011ASA | ED3MOD01 | ED3MOD04 | |
| 124. | 1.89E-09 | 3 | ADAEP001ASA | ED3MOD01 | ED3MOD04 | |
| 125. | 1.89E-09 | 4 | PMA0301ASA | ZO1DG001TM | EC0MOD01 | ED3MOD03 |
| 126. | 1.89E-09 | 4 | PMA0301BSA | ZO1DG001TM | EC0MOD01 | ED3MOD03 |
| 127. | 1.87E-09 | 4 | MDAS | PMA0301ASA | EC1CB100VO | EC0MOD01 |
| 128. | 1.87E-09 | 4 | MDAS | PMA0301BSA | EC1CB100VO | EC0MOD01 |
| 129. | 1.81E-09 | 4 | MDAS | IDABSDS1TM | ZO1DG001TM | EC0MOD01 |
| 130. | 1.74E-09 | 3 | REC-MANDAS | CCX-PMAMOD2 | ADW-MAN01 | |
| 131. | 1.72E-09 | 3 | PMAMOD11 | EC1BS001TM | ED3MOD07 | |
| 132. | 1.72E-09 | 3 | PMAMOD11 | EC1BS012TM | ED3MOD07 | |
| 133. | 1.72E-09 | 3 | PMAMOD11 | EC1BS121TM | ED3MOD07 | |
| 134. | 1.69E-09 | 3 | PMAMOD11 | EC1BS001TM | ED3BSDS1TM | |
| 135. | 1.67E-09 | 3 | MDAS | PMAXS00ASA | PMAMOD12 | |
| 136. | 1.67E-09 | 3 | MDAS | PMAXS00ASA | PMAMOD11 | |
| 137. | 1.58E-09 | 4 | REC-MANDAS | IDAMOD05 | ZO1MOD01 | EC0MOD01 |
| 138. | 1.58E-09 | 3 | PMA0301ASA | EC1BS001TM | ED3MOD01 | |
| 139. | 1.58E-09 | 3 | PMA0301BSA | EC1BS001TM | ED3MOD01 | |
| 140. | 1.56E-09 | 3 | PMAMOD11 | EC0MOD01 | CCX-BY-PN1 | |

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| 141. | 1.56E-09 | 3 | CCX-PMAMOD1 | ED3MOD01 | ED3MOD04 | |
| 142. | 1.50E-09 | 3 | MDAS | CCX-PMAMOD2 | ADN-MAN01 | |
| 143. | 1.49E-09 | 4 | PMAMOD11 | ZO1MOD01 | EC0MOD01 | ED3MOD03 |
| 144. | 1.47E-09 | 3 | REC-MANDAS | CCX-BY-PN | EC1BS001TM | |
| 145. | 1.47E-09 | 3 | REC-MANDAS | CCX-BY-PN | EC1BS012TM | |
| 146. | 1.47E-09 | 3 | REC-MANDAS | CCX-BY-PN | EC1BS121TM | |
| 147. | 1.37E-09 | 4 | MDAS | IDAMOD05 | ZO1MOD01 | EC0MOD01 |
| 148. | 1.33E-09 | 3 | PMAMOD11 | PMAMOD12 | ED3MOD07 | |
| 149. | 1.27E-09 | 3 | MDAS | CCX-BY-PN | EC1BS001TM | |
| 150. | 1.27E-09 | 3 | MDAS | CCX-BY-PN | EC1BS012TM | |
| 151. | 1.27E-09 | 3 | MDAS | CCX-BY-PN | EC1BS121TM | |
| 152. | 1.25E-09 | 3 | ADAEP011ASA | ED3MOD03 | EC1BS001TM | |
| 153. | 1.25E-09 | 3 | ADAEP001ASA | ED3MOD03 | EC1BS001TM | |
| 154. | 1.17E-09 | 3 | REC-MANDAS | IDAMOD04 | IDAMOD08 | |
| 155. | 1.16E-09 | 3 | REC-MANDAS | PMAMOD11 | EC1MOD12 | |
| 156. | 1.12E-09 | 3 | ADAEP011ASA | ED3MOD04 | ED3BSDS1TM | |
| 157. | 1.12E-09 | 3 | ADAEP001ASA | ED3MOD04 | ED3BSDS1TM | |
| 158. | 1.08E-09 | 3 | REC-MANDAS | PMAXS00ASA | PMA0302ASA | |
| 159. | 1.08E-09 | 3 | REC-MANDAS | PMAXS00ASA | PMA0301ASA | |
| 160. | 1.07E-09 | 3 | CCX-PMA030 | ED3MOD01 | ED3MOD04 | |
| 161. | 1.05E-09 | 3 | REC-MANDAS | PMAMOD11 | IDAMOD06 | |
| 162. | 1.03E-09 | 3 | CCX-PMAMOD1 | ED3MOD03 | EC1BS001TM | |
| 163. | 1.00E-09 | 3 | MDAS | IDAMOD04 | IDAMOD08 | |
| 164. | 1.00E-09 | 3 | MDAS | PMAMOD11 | EC1MOD12 | |
| 165. | 9.80E-10 | 3 | REC-MANDAS | CMX-VS-FA | LPM-MAN03 | |
| 166. | 9.73E-10 | 4 | REC-MANDAS | IDAMOD04 | ZO1MOD01 | EC0MOD01 |
| 167. | 9.64E-10 | 4 | REC-MANDAS | IDAMOD05 | EC1CB100VO | EC0MOD01 |
| 168. | 9.55E-10 | 3 | PMA0301ASA | EC1BS001TM | ED3MOD07 | |
| 169. | 9.55E-10 | 3 | PMA0301ASA | EC1BS012TM | ED3MOD07 | |
| 170. | 9.55E-10 | 3 | PMA0301ASA | EC1BS121TM | ED3MOD07 | |
| 171. | 9.55E-10 | 3 | PMA0301BSA | EC1BS001TM | ED3MOD07 | |
| 172. | 9.55E-10 | 3 | PMA0301BSA | EC1BS012TM | ED3MOD07 | |
| 173. | 9.55E-10 | 3 | PMA0301BSA | EC1BS121TM | ED3MOD07 | |
| 174. | 9.40E-10 | 3 | PMA0301ASA | EC1BS001TM | ED3BSDS1TM | |
| 175. | 9.40E-10 | 3 | PMA0301BSA | EC1BS001TM | ED3BSDS1TM | |
| 176. | 9.28E-10 | 3 | MDAS | PMAXS00ASA | PMA0302ASA | |
| 177. | 9.28E-10 | 3 | MDAS | PMAXS00ASA | PMA0301ASA | |
| 178. | 9.26E-10 | 3 | CCX-PMAMOD1 | ED3MOD04 | ED3BSDS1TM | |
| 179. | 9.21E-10 | 4 | REC-MANDAS | IDABSDS1TM | ZO1MOD01 | EC0MOD01 |
| 180. | 9.09E-10 | 4 | PMAMOD11 | EC1CB100VO | EC0MOD01 | ED3MOD03 |
| 181. | 9.03E-10 | 3 | MDAS | PMAMOD11 | IDAMOD06 | |
| 182. | 8.66E-10 | 3 | PMA0301ASA | EC0MOD01 | CCX-BY-PN1 | |
| 183. | 8.66E-10 | 3 | PMA0301BSA | EC0MOD01 | CCX-BY-PN1 | |
| 184. | 8.58E-10 | 4 | REC-MANDAS | PMAMOD11 | EC0MOD01 | ED1MOD03 |
| 185. | 8.45E-10 | 3 | MDAS | CMX-VS-FA | LPM-MAN03 | |
| 186. | 8.40E-10 | 4 | IDAMOD05 | ZO1DG001TM | EC0MOD01 | ED3MOD03 |
| 187. | 8.39E-10 | 4 | MDAS | IDAMOD04 | ZO1MOD01 | EC0MOD01 |
| 188. | 8.31E-10 | 4 | MDAS | IDAMOD05 | EC1CB100VO | EC0MOD01 |
| 189. | 8.29E-10 | 4 | PMA0301ASA | ZO1MOD01 | EC0MOD01 | ED3MOD03 |
| 190. | 8.29E-10 | 4 | PMA0301BSA | ZO1MOD01 | EC0MOD01 | ED3MOD03 |
| 191. | 7.94E-10 | 4 | MDAS | IDABSDS1TM | ZO1MOD01 | EC0MOD01 |
| 192. | 7.52E-10 | 3 | REC-MANDAS | CCX-IV-XR | EC1BS001TM | |
| 193. | 7.52E-10 | 3 | REC-MANDAS | CCX-IV-XR | EC1BS012TM | |
| 194. | 7.52E-10 | 3 | REC-MANDAS | CCX-IV-XR | EC1BS121TM | |
| 195. | 7.39E-10 | 3 | PMAMOD12 | PMA0301ASA | ED3MOD07 | |

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| 196. | 7.39E-10 | 3 | PMAMOD11 | PMA0302ASA | ED3MOD07 | |
| 197. | 7.39E-10 | 3 | PMA0301BSA | PMAMOD12 | ED3MOD07 | |
| 198. | 7.39E-10 | 3 | PMAMOD11 | PMA0302BSA | ED3MOD07 | |
| 199. | 7.39E-10 | 4 | MDAS | PMAMOD11 | EC0MOD01 | ED1MOD03 |
| 200. | 7.06E-10 | 3 | CCX-PMA030 | ED3MOD03 | EC1BS001TM | |
| 201. | 7.02E-10 | 3 | IDAMOD05 | EC1BS001TM | ED3MOD01 | |
| 202. | 6.48E-10 | 3 | MDAS | CCX-IV-XR | EC1BS001TM | |
| 203. | 6.48E-10 | 3 | MDAS | CCX-IV-XR | EC1BS012TM | |
| 204. | 6.48E-10 | 3 | MDAS | CCX-IV-XR | EC1BS121TM | |
| 205. | 6.46E-10 | 3 | REC-MANDAS | PMA0301ASA | EC1MOD12 | |
| 206. | 6.46E-10 | 3 | REC-MANDAS | PMA0301BSA | EC1MOD12 | |
| 207. | 6.37E-10 | 3 | CCX-PMA030 | ED3MOD04 | ED3BSDS1TM | |
| 208. | 6.35E-10 | 4 | REC-MANDAS | PMAMOD11 | ZOX-PD-ES | EC0MOD01 |
| 209. | 6.35E-10 | 4 | PMAMOD11 | ZO1DG001TM | EC0MOD01 | ED3MOD01 |
| 210. | 5.93E-10 | 4 | REC-MANDAS | IDAMOD04 | EC1CB100VO | EC0MOD01 |
| 211. | 5.89E-10 | 3 | REC-MANDAS | CCX-INPUT-LOGIC | ADM-MAN01 | |
| 212. | 5.83E-10 | 3 | PMAXS00ASA | EC1BS001TM | ED3MOD03 | |
| 213. | 5.81E-10 | 3 | REC-MANDAS | PMA0301ASA | IDAMOD06 | |
| 214. | 5.81E-10 | 3 | REC-MANDAS | PMA0301BSA | IDAMOD06 | |
| 215. | 5.61E-10 | 4 | REC-MANDAS | IDABSDS1TM | EC1CB100VO | EC0MOD01 |
| 216. | 5.59E-10 | 4 | REC-MANDAS | PMAXS00ASA | ZO1DG001TM | EC0MOD01 |
| 217. | 5.57E-10 | 3 | MDAS | PMA0301ASA | EC1MOD12 | |
| 218. | 5.57E-10 | 3 | MDAS | PMA0301BSA | EC1MOD12 | |
| 219. | 5.48E-10 | 4 | MDAS | PMAMOD11 | ZOX-PD-ES | EC0MOD01 |
| 220. | 5.16E-10 | 4 | IDAMOD04 | ZO1DG001TM | EC0MOD01 | ED3MOD03 |
| 221. | 5.11E-10 | 4 | MDAS | IDAMOD04 | EC1CB100VO | EC0MOD01 |
| 222. | 5.08E-10 | 3 | MDAS | CCX-INPUT-LOGIC | ADM-MAN01 | |
| 223. | 5.05E-10 | 4 | PMA0301ASA | EC1CB100VO | EC0MOD01 | ED3MOD03 |
| 224. | 5.05E-10 | 4 | PMA0301BSA | EC1CB100VO | EC0MOD01 | ED3MOD03 |
| 225. | 5.01E-10 | 3 | MDAS | PMA0301ASA | IDAMOD06 | |
| 226. | 5.01E-10 | 3 | MDAS | PMA0301BSA | IDAMOD06 | |
| 227. | 4.88E-10 | 4 | IDABSDS1TM | ZO1DG001TM | EC0MOD01 | ED3MOD03 |
| 228. | 4.83E-10 | 4 | MDAS | IDABSDS1TM | EC1CB100VO | EC0MOD01 |
| 229. | 4.82E-10 | 4 | MDAS | PMAXS00ASA | ZO1DG001TM | EC0MOD01 |
| 230. | 4.76E-10 | 4 | REC-MANDAS | PMA0301ASA | EC0MOD01 | ED1MOD03 |
| 231. | 4.76E-10 | 4 | REC-MANDAS | PMA0301BSA | EC0MOD01 | ED1MOD03 |
| 232. | 4.31E-10 | 3 | IDAMOD04 | EC1BS001TM | ED3MOD01 | |
| 233. | 4.25E-10 | 3 | IDAMOD05 | EC1BS001TM | ED3MOD07 | |
| 234. | 4.25E-10 | 3 | IDAMOD05 | EC1BS012TM | ED3MOD07 | |
| 235. | 4.25E-10 | 3 | IDAMOD05 | EC1BS121TM | ED3MOD07 | |
| 236. | 4.23E-10 | 4 | REC-MANDAS | PMAMOD22 | PMAMOD21 | LPM-MAN03 |
| 237. | 4.18E-10 | 3 | IDAMOD05 | EC1BS001TM | ED3BSDS1TM | |
| 238. | 4.10E-10 | 3 | PMA0301ASA | PMA0302ASA | ED3MOD07 | |
| 239. | 4.10E-10 | 4 | MDAS | PMA0301ASA | EC0MOD01 | ED1MOD03 |
| 240. | 4.10E-10 | 4 | MDAS | PMA0301BSA | EC0MOD01 | ED1MOD03 |
| 241. | 4.08E-10 | 3 | IDABSDS1TM | EC1BS001TM | ED3MOD01 | |
| 242. | 4.07E-10 | 3 | REC-MANDAS | PMAMOD11 | EC1MOD121 | |
| 243. | 3.97E-10 | 4 | REC-MANDAS | PMAMOD11 | ZO1MOD04 | EC0MOD01 |
| 244. | 3.85E-10 | 3 | IDAMOD05 | EC0MOD01 | CCX-BY-PN1 | |
| 245. | 3.84E-10 | 4 | PMAMOD11 | ZO1DG001TM | EC0MOD01 | ED3MOD07 |
| 246. | 3.81E-10 | 4 | REC-MANDAS | PMAMOD11 | ECX-CB-GO | EC0MOD01 |
| 247. | 3.78E-10 | 4 | PMAMOD11 | ZO1DG001TM | EC0MOD01 | ED3BSDS1TM |
| 248. | 3.69E-10 | 4 | IDAMOD05 | ZO1MOD01 | EC0MOD01 | ED3MOD03 |
| 249. | 3.66E-10 | 2 | CCX-SFTW | ED3MOD07 | | |
| 250. | 3.64E-10 | 4 | MDAS | PMAMOD22 | PMAMOD21 | LPM-MAN03 |

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| 251. | 3.54E-10 | 4 | REC-MANDAS | PMAMOD11 | ZO1DG001TM | ED4MOD112 |
| 252. | 3.54E-10 | 4 | REC-MANDAS | PMAMOD11 | ZO1DG001TM | ED4MOD11 |
| 253. | 3.53E-10 | 4 | REC-MANDAS | PMA0301ASA | ZOX-PD-ES | EC0MOD01 |
| 254. | 3.53E-10 | 4 | REC-MANDAS | PMA0301BSA | ZOX-PD-ES | EC0MOD01 |
| 255. | 3.52E-10 | 4 | PMA0301ASA | ZO1DG001TM | EC0MOD01 | ED3MOD01 |
| 256. | 3.52E-10 | 4 | PMA0301BSA | ZO1DG001TM | EC0MOD01 | ED3MOD01 |
| 257. | 3.51E-10 | 3 | MDAS | PMAMOD11 | EC1MOD121 | |
| 258. | 3.43E-10 | 3 | CCX-BY-PN | EC1BS001TM | ED3MOD03 | |
| 259. | 3.42E-10 | 4 | MDAS | PMAMOD11 | ZO1MOD04 | EC0MOD01 |
| 260. | 3.35E-10 | 4 | REC-MANDAS | PMAMOD11 | ZO1DG001TM | ED4BSDS1TM |
| 261. | 3.29E-10 | 4 | MDAS | PMAMOD11 | ECX-CB-GO | EC0MOD01 |
| 262. | 3.29E-10 | 4 | REC-MANDAS | CCX-BY-PN | ZO1DG001TM | EC0MOD01 |
| 263. | 3.22E-10 | 3 | PMAMOD11 | EC1BS001TM | CCX-BY-PN1 | |
| 264. | 3.22E-10 | 3 | PMAMOD11 | CCX-BY-PN1 | EC2BS023TM | |
| 265. | 3.22E-10 | 3 | PMAMOD11 | CCX-BY-PN1 | EC2BS002TM | |
| 266. | 3.05E-10 | 4 | MDAS | PMAMOD11 | ZO1DG001TM | ED4MOD112 |
| 267. | 3.05E-10 | 4 | MDAS | PMAMOD11 | ZO1DG001TM | ED4MOD11 |
| 268. | 3.04E-10 | 2 | ALL-IND-FAIL | CCX-PMAMOD2 | | |
| 269. | 3.04E-10 | 4 | MDAS | PMA0301ASA | ZOX-PD-ES | EC0MOD01 |
| 270. | 3.04E-10 | 4 | MDAS | PMA0301BSA | ZOX-PD-ES | EC0MOD01 |
| 271. | 2.94E-10 | 3 | REC-MANDAS | PMAXS00ASA | IDAMOD08 | |
| 272. | 2.94E-10 | 3 | REC-MANDAS | PMAXS00ASA | IDAMOD04 | |
| 273. | 2.88E-10 | 4 | MDAS | PMAMOD11 | ZO1DG001TM | ED4BSDS1TM |
| 274. | 2.87E-10 | 3 | REC-MANDAS | IDAMOD05 | EC1MOD12 | |
| 275. | 2.83E-10 | 4 | MDAS | CCX-BY-PN | ZO1DG001TM | EC0MOD01 |
| 276. | 2.81E-10 | 3 | REC-MANDAS | CCX-IN-LOGIC-SW | LPM-MAN03 | |
| 277. | 2.81E-10 | 3 | REC-MANDAS | CCX-PMAMOD2-SW | LPM-MAN03 | |
| 278. | 2.80E-10 | 4 | REC-MANDAS | PMAMOD21 | LPM-MAN03 | EC1BS001TM |
| 279. | 2.80E-10 | 4 | REC-MANDAS | PMAMOD21 | LPM-MAN03 | EC1BS012TM |
| 280. | 2.80E-10 | 4 | REC-MANDAS | PMAMOD21 | LPM-MAN03 | EC1BS121TM |
| 281. | 2.79E-10 | 4 | PMAMOD11 | ZO1MOD01 | EC0MOD01 | ED3MOD01 |
| 282. | 2.78E-10 | 4 | ADAEP011ASA | ED3MOD03 | ZO1DG001TM | EC0MOD01 |
| 283. | 2.78E-10 | 4 | ADAEP001ASA | ED3MOD03 | ZO1DG001TM | EC0MOD01 |
| 284. | 2.74E-10 | 4 | REC-MANDAS | PMAMOD12 | IDAMOD05 | IDAMOD07 |
| 285. | 2.61E-10 | 3 | IDAMOD04 | EC1BS001TM | ED3MOD07 | |
| 286. | 2.61E-10 | 3 | IDAMOD04 | EC1BS012TM | ED3MOD07 | |
| 287. | 2.61E-10 | 3 | IDAMOD04 | EC1BS121TM | ED3MOD07 | |
| 288. | 2.59E-10 | 3 | REC-MANDAS | IDAMOD05 | IDAMOD06 | |
| 289. | 2.57E-10 | 3 | IDAMOD04 | EC1BS001TM | ED3BSDS1TM | |
| 290. | 2.56E-10 | 3 | MDAS | PMAXS00ASA | IDAMOD08 | |
| 291. | 2.56E-10 | 3 | MDAS | PMAXS00ASA | IDAMOD04 | |
| 292. | 2.48E-10 | 3 | MDAS | IDAMOD05 | EC1MOD12 | |
| 293 | 2.47E-10 | 3 | IDABSDS1TM | EC1BS001TM | ED3MOD07 | |
| 294. | 2.47E-10 | 3 | IDABSDS1TM | EC1BS012TM | ED3MOD07 | |
| 295. | 2.47E-10 | 3 | IDABSDS1TM | EC1BS121TM | ED3MOD07 | |
| 296. | 2.46E-10 | 4 | REC-MANDAS | PMAXS00ASA | ZO1MOD01 | EC0MOD01 |
| 297. | 2.43E-10 | 3 | IDABSDS1TM | EC1BS001TM | ED3BSDS1TM | |
| 298. | 2.42E-10 | 3 | MDAS | CCX-IN-LOGIC-SW | LPM-MAN03 | |
| 299. | 2.42E-10 | 3 | MDAS | CCX-PMAMOD2-SW | LPM-MAN03 | |
| 300. | 2.42E-10 | 4 | MDAS | PMAMOD21 | LPM-MAN03 | EC1BS001TM |
| 301. | 2.42E-10 | 4 | MDAS | PMAMOD21 | LPM-MAN03 | EC1BS012TM |
| 302. | 2.42E-10 | 4 | MDAS | PMAMOD21 | LPM-MAN03 | EC1BS121TM |
| 303. | 2.37E-10 | 3 | IDAMOD04 | EC0MOD01 | CCX-BY-PN1 | |
| 304. | 2.36E-10 | 4 | MDAS | PMAMOD12 | IDAMOD05 | IDAMOD07 |
| 305. | 2.33E-10 | 3 | ADAEP011ASA | ED3MOD01 | EC1BS001TM | |

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| 306. | 2.33E-10 | 3 | ADAEP011ASA | ED3MOD01 | EC1BS011TM | |
| 307. | 2.33E-10 | 3 | ADAEP011ASA | ED3MOD01 | EC1BS111TM | |
| 308. | 2.33E-10 | 3 | ADAEP001ASA | ED3MOD01 | EC1BS001TM | |
| 309. | 2.33E-10 | 3 | ADAEP001ASA | ED3MOD01 | EC1BS011TM | |
| 310. | 2.33E-10 | 3 | ADAEP001ASA | ED3MOD01 | EC1BS111TM | |
| 311. | 2.32E-10 | 4 | REC-MANDAS | PMAMOD11 | ECX-CB-GC | EC0MOD01 |
| 312. | 2.29E-10 | 4 | CCX-PMAMOD1 | ED3MOD03 | ZO1DG001TM | EC0MOD01 |
| 313. | 2.28E-10 | 4 | REC-MANDAS | IDAMOD02 | IDAMOD03 | EC1BS001TM |
| 314. | 2.28E-10 | 4 | REC-MANDAS | IDAMOD02 | IDAMOD03 | EC1BS012TM |
| 315. | 2.28E-10 | 4 | REC-MANDAS | IDAMOD02 | IDAMOD03 | EC1BS121TM |
| 316. | 2.26E-10 | 4 | IDAMOD04 | ZO1MOD01 | EC0MOD01 | ED3MOD03 |
| 317. | 2.26E-10 | 3 | REC-MANDAS | PMA0301ASA | EC1MOD121 | |
| 318. | 2.26E-10 | 3 | REC-MANDAS | PMA0301BSA | EC1MOD121 | |
| 319. | 2.26E-10 | 4 | IDAMOD05 | EC1CB100VO | EC0MOD01 | ED3MOD03 |
| 320. | 2.24E-10 | 3 | IDABSDS1TM | EC0MOD01 | CCX-BY-PW1 | |
| 321. | 2.23E-10 | 3 | MDAS | IDAMOD05 | IDAMOD06 | |
| 322. | 2.20E-10 | 4 | REC-MANDAS | PMA0301ASA | ZO1MOD04 | EC0MOD01 |
| 323. | 2.20E-10 | 4 | REC-MANDAS | PMA0301BSA | ZO1MOD04 | EC0MOD01 |
| 324. | 2.20E-10 | 3 | REC-MANDAS | CMX-VS-FA | AND-MAN01 | |
| 325. | 2.17E-10 | 4 | REC-MANDAS | PMAMOD11 | PMAMOD22 | LPM-MAN03 |
| 326. | 2.17E-10 | 4 | REC-MANDAS | PMAMOD12 | PMAMOD21 | LPM-MAN03 |
| 327. | 2.16E-10 | 4 | IDABSDS1TM | ZO1MOD01 | EC0MOD01 | ED3MOD03 |
| 328. | 2.13E-10 | 4 | PMA0301ASA | ZO1DG001TM | EC0MOD01 | ED3MOD07 |
| 329. | 2.13E-10 | 4 | PMA0301BSA | ZO1DG001TM | EC0MOD01 | ED3MOD07 |
| 330. | 2.12E-10 | 4 | REC-MANDAS | IDAMOD05 | EC0MOD01 | ED1MOD03 |
| 331. | 2.12E-10 | 4 | MDAS | PMAXS00ASA | ZO1MOD01 | EC0MOD01 |
| 332. | 2.12E-10 | 4 | REC-MANDAS | PMA0301ASA | ECX-CB-GC | EC0MOD01 |
| 333. | 2.12E-10 | 4 | REC-MANDAS | PMA0301BSA | ECX-CB-GO | EC0MOD01 |
| 334. | 2.10E-10 | 4 | PMA0301ASA | ZO1DG^01TM | EC0MOD01 | ED3BSDS1TM |
| 335. | 2.10E-10 | 4 | PMA0301BSA | ZO1DG001TM | EC0MOD01 | ED3BSDS1TM |
| 336. | 3.04E-10 | 3 | CCX-PMAMOD2 | LPM-MAN03 | ED3MOD07 | |
| 337. | 2.02E-10 | 3 | PMAMOD12 | IDAMOD04 | ED3MOD07 | |
| 338. | 2.02E-10 | 3 | PMAMOD11 | IDAMOD08 | ED3MOD07 | |
| 339. | 2.00E-10 | 4 | MDAS | PMAMOD11 | ECX-CB-GC | EC0MOD01 |
| 340. | 2.00E-10 | 4 | PMAMOD11 | EC0MOD01 | ED1MOD03 | ED3MOD03 |
| 341. | 1.97E-10 | 4 | MDAS | IDAMOD02 | IDAMOD03 | EC1BS001TM |
| 342. | 1.97E-10 | 4 | MDAS | IDAMOD02 | IDAMOD03 | EC1BS012TM |
| 343. | 1.97E-10 | 4 | MDAS | IDAMOD02 | IDAMOD03 | EC1BS121TM |
| 344. | 1.96E-10 | 4 | REC-MANDAS | PMA0301ASA | ZO1DG001TM | ED4MOD112 |
| 345. | 1.96E-10 | 4 | REC-MANDAS | PMA0301ASA | ZO1DG001TM | ED4MOD11 |
| 366. | 1.96E-10 | 4 | REC-MANDAS | PMA0301BSA | ZO1DG001TM | ED4MOD112 |
| 347. | 1.96E-10 | 4 | REC-MANDAS | PMA0301BSA | ZO1DG001TM | ED4MOD11 |
| 348. | 1.95E-10 | 3 | MDAS | PMA0301ASA | EC1MOD121 | |
| 349. | 1.95E-10 | 3 | MDAS | PMA0301BSA | EC1MOD121 | |
| 350. | 1.92E-10 | 3 | CCX-PMAMOD1 | ED3MOD01 | EC1BS001TM | |
| 351. | 1.92E-10 | 3 | CCX-PMAMOD1 | ED3MOD01 | EC1BS011TM | |
| 352. | 1.92E-10 | 3 | CCX-PMAMOD1 | ED3MOD01 | EC1BS111TM | |
| 353. | 1.90E-10 | 4 | MDAS | PMA0301ASA | ZO1MOD04 | EC0MOD01 |
| 354. | 1.90E-10 | 4 | MDAS | PMA0301BSA | ZO1MOD04 | EC0MOD01 |
| 355. | 1.89E-10 | 3 | MDAS | CMX-VS-FA | AND-MAN01 | |
| 356. | 1.87E-10 | 4 | MDAS | PMAMOD11 | PMAMOD22 | LPM-MAN03 |
| 357. | 1.87E-10 | 4 | MDAS | PMAMOD12 | PMAMOD21 | LPM-MAN03 |
| 358. | 1.86E-10 | 4 | REC-MANDAS | PMA0301ASA | ZO1DG001TM | ED4BSDS1TM |
| 359. | 1.86E-10 | 4 | REC-MANDAS | PMA0301BSA | ZO1DG001TM | ED4BSDS1TM |
| 360. | 1.83E-10 | 4 | MDAS | IDAMOD05 | EC0MOD01 | ED1MOD03 |

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| 361. | 1.82E-10 | 4 | MDAS | PMA0301ASA | ECX-CB-GO | EC0MOD01 |
| 362. | 1.82E-10 | 4 | MDAS | PMA0301BSA | ECX-CB-GO | EC0MOD01 |
| 363. | 1.79E-10 | 3 | PMA0301ASA | EC1BS001TM | CCX-BY-PN1 | |
| 364. | 1.79E-10 | 3 | PMA0301ASA | CCX-BY-PN1 | EC2BS023TM | |
| 365. | 1.79E-10 | 3 | PMA0301ASA | CCX-BY-PN1 | EC2BS002TM | |
| 366. | 1.79E-10 | 3 | PMA0301BSA | EC1BS001TM | CCX-BY-PN1 | |
| 367. | 1.79E-10 | 3 | PMA0301BSA | CCX-BY-PN1 | EC2BS023TM | |
| 368. | 1.79E-10 | 3 | PMA0301BSA | CCX-BY-PN1 | EC2BS002TM | |
| 369. | 1.77E-10 | 3 | REC-MANDAS | IDAMOD04 | EC1MOD12 | |
| 370. | 1.76E-10 | 3 | REC-MANDAS | CCX-PMAMOD2 | CCX-PMAMOD4 | |
| 371. | 1.75E-10 | 3 | CCX-IV-XR | EC1BS001TM | ED3MOD03 | |
| 372. | 1.71E-10 | 2 | ALL-IND-FAIL | ADAEP011ASA | | |
| 373. | 1.71E-10 | 2 | ALL-IND-FAIL | ADAEP001ASA | | |
| 374. | 1.70E-10 | 4 | PMAMOD11 | EC1CB100VO | EC0MOD01 | ED3MOD01 |
| 375. | 1.69E-10 | 4 | MDAS | PMA0301ASA | ZO1DG001TM | ED4MOD112 |
| 376. | 1.69E-10 | 4 | MDAS | PMA0301ASA | ZO1DG001TM | ED4MOD11 |
| 377. | 1.69E-10 | 4 | MDAS | PMA0301BSA | ZO1DG001TM | ED4MOD112 |
| 378. | 1.69E-10 | 4 | MDAS | PMA0301BSA | ZO1DG001TM | ED4MOD11 |
| 379. | 1.69E-10 | 4 | PMAMOD11 | ZO1MOD01 | EC0MOD01 | ED3MOD07 |
| 380. | 1.68E-10 | 4 | REC-MANDAS | CCX-IV-XR | ZO1DG001TM | EC0MOD01 |
| 381. | 1.67E-10 | 3 | REC-MANDAS | IDABSDS1TM | EC1MOD12 | |
| 382. | 1.66E-10 | 4 | PMAMOD11 | ZO1MOD01 | EC0MOD01 | ED3BSDS1TM |
| 383. | 1.60E-10 | 4 | MDAS | PMA0301ASA | ZO1DG001TM | ED4BSDS1TM |
| 384. | 1.60E-10 | 4 | MDAS | PMA0301BSA | ZO1DG001TM | ED4BSDS1TM |
| 385. | 1.59E-10 | 4 | REC-MANDAS | PMAMOD12 | IDAMOD07 | IDABSDS1TM |
| 386. | 1.59E-10 | 3 | REC-MANDAS | IDAMOD04 | IDAMOD06 | |
| 387. | 1.58E-10 | 4 | CCX-PMA030 | ED3MOD03 | ZO1DG001TM | EC0MOD01 |
| 388. | 1.57E-10 | 4 | REC-MANDAS | IDAMOD05 | ZOX-PD-ES | EC0MOD01 |
| 389. | 1.57E-10 | 4 | IDAMOD05 | ZO1DG001TM | EC0MOD01 | ED3MOD01 |
| 390. | 1.55E-10 | 4 | REC-MANDAS | PMAMOD11 | ZO1MOD01 | ED4MOD112 |
| 391. | 1.55E-10 | 4 | REC-MANDAS | PMAMOD11 | ZO1MOD01 | ED4MOD11 |
| 392. | 1.55E-10 | 4 | PMA0301ASA | ZO1MOD01 | EC0MOD01 | ED3MOD01 |
| 393. | 1.55E-10 | 4 | PMA0301BSA | ZO1MOD01 | EC0MOD01 | ED3MOD01 |
| 394. | 1.52E-10 | 3 | MDAS | IDAMOD04 | EC1MOD12 | |
| 395. | 1.52E-10 | 4 | REC-MANDAS | PMA0302ASA | IDAMOD05 | IDAMOD07 |
| 396. | 1.52E-10 | 4 | REC-MANDAS | PMA0302BSA | IDAMOD05 | IDAMOD07 |
| 397. | 1.51E-10 | 3 | MDAS | CCX-PMAMOD2 | CCX-PMAMOD4 | |
| 398. | 1.50E-10 | 3 | REC-MANDAS | IDABSDS1LF | EC1BS001TM | |
| 399. | 1.50E-10 | 3 | REC-MANDAS | IDABSDS1LF | EC1BS012TM | |
| 400. | 1.50E-10 | 3 | REC-MANDAS | IDABSDS1LF | EC1BS121TM | |
| 401. | 1.50E-10 | 3 | REC-MANDAS | IDAMOD06 | IDABSDS1TM | |
| 402. | 1.50E-10 | 4 | REC-MANDAS | PMAXS00ASA | EC1CB100VO | EC0MOD01 |
| 403. | 1.48E-10 | 4 | PMAMOD11 | ZOX-PD-ES | EC0MOD01 | ED3MOD03 |
| 404. | 1.47E-10 | 4 | REC-MANDAS | PMAMOD11 | ZO1MOD01 | ED4BSDS1TM |
| 405. | 1.45E-10 | 4 | MDAS | CCX-IV-XR | ZO1DG001TM | EC0MOD01 |
| 406. | 1.44E-10 | 4 | REC-MANDAS | CCX-BY-PN | ZO1MOD01 | EC0MOD01 |
| 407. | 1.44E-10 | 3 | MDAS | IDABSDS1TM | EC1MOD12 | |
| 408. | 1.41E-10 | 2 | ALL-IND-FAIL | CCX-PMAMOD1 | | |
| 409. | 1.40E-10 | 4 | REC-MANDAS | PMAMOD11 | ZOX-DG-DR | EC0MOD01 |
| 410. | 1.39E-10 | 3 | ADAEP011ASA | ED3BSDS1TM | EC1BS001TM | |
| 411. | 1.39E-10 | 3 | ADAEP011ASA | ED3BSDS1TM | EC1BS011TM | |
| 412. | 1.39E-10 | 3 | ADAEP011ASA | ED3BSDS1TM | EC1BS111TM | |
| 413. | 1.39E-10 | 3 | ADAEP001ASA | ED3BSDS1TM | EC1BS001TM | |
| 414. | 1.39E-10 | 3 | ADAEP001ASA | ED3BSDS1TM | EC1BS011TM | |
| 415. | 1.39E-10 | 3 | ADAEP001ASA | ED3BSDS1TM | EC1BS111TM | |

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|---|---|---|---|---|---|---|
| 416. | 1.38E-10 | 4 | IDAMOD04 | EC1CB100VO | EC0MOD01 | ED3MOD03 |
| 417. | 1.37E-10 | 4 | MDAS | PMAMOD12 | IDAMOD07 | IDABSDS1TM |
| 418. | 1.37E-10 | 3 | MDAS | IDAMOD04 | IDAMOD06 | |
| 419. | 1.35E-10 | 3 | PMAMOD11 | EC1BS001TM | CCX-IV-XR1 | |
| 420. | 1.35E-10 | 4 | MDAS | IDAMOD05 | ZOX-FD-ES | EC0MOD01 |
| 421. | 1.34E-10 | 4 | MDAS | PMAMOD11 | ZO1MOD01 | ED4MOD112 |
| 422. | 1.34E-10 | 4 | MDAS | PMAMOD11 | ZO1MOD01 | ED4MOD11 |
| 423. | 1.32E-10 | 3 | CCX-PMA030 | ED3MOD01 | EC1BS001TM | |
| 424. | 1.32E-10 | 3 | CCX-PMA030 | ED3MOD01 | EC1BS011TM | |
| 425. | 1.32E-10 | 3 | CCX-PMA030 | ED3MOD01 | EC1BS111TM | |
| 426. | 1.31E-10 | 4 | MDAS | PMA0302ASA | IDAMOD05 | IDAMOD07 |
| 427. | 1.31E-10 | 4 | MDAS | PMA0302BSA | IDAMOD05 | IDAMOD07 |
| 428. | 1.31E-10 | 4 | IDABSDS1TM | EC1CB100VO | EC0MOD01 | ED3MOD03 |
| 429. | 1.30E-10 | 4 | PMAXS00ASA | ZO1DG001TM | EC0MOD01 | ED3MOD03 |
| 430. | 1.30E-10 | 4 | REC-MANDAS | IDAMOD04 | EC0MOD01 | ED1MOD03 |
| 431. | 1.30E-10 | 3 | MDAS | IDABSDS1LF | EC1BS001TM | |
| 432. | 1.30E-10 | 3 | MDAS | IDABSDS1LF | EC1BS012TM | |
| 433. | 1.30E-10 | 3 | MDAS | IDABSDS1LF | EC1BS121TM | |
| 434. | 1.30E-10 | 3 | MDAS | IDAMOD06 | IDABSDS1TM | |
| 435. | 1.29E-10 | 4 | MDAS | PMAXS00ASA | EC1CB100VO | EC0MOD01 |
| 436. | 1.29E-10 | 4 | REC-MANDAS | PMA0301ASA | ECX-CB-GC | EC0MOD01 |
| 437. | 1.29E-10 | 4 | REC-MANDAS | PMA0301BSA | ECX-CB-GC | EC0MOD01 |
| 438. | 1.28E-10 | 3 | ADAEP011ASA | CCX-BY-PN1 | EC0MOD01 | |
| 439. | 1.28E-10 | 3 | ADAEP001ASA | CCX-BY-PN1 | EC0MOD01 | |
| 440. | 1.27E-10 | 4 | MDAS | PMAMOD11 | ZO1MOD01 | ED4BSDS1TM |
| 441. | 1.24E-10 | 4 | MDAS | CCX-BY-PN | ZO1MOD01 | EC0MOD01 |
| 442. | 1.23E-10 | 4 | REC-MANDAS | IDABSDS1TM | EC0MOD01 | ED1MOD03 |
| 443. | 1.22E-10 | 4 | ADAEP011ASA | ED3MOD03 | ZO1MOD01 | EC0MOD01 |
| 444. | 1.22E-10 | 4 | ADAEP001ASA | ED3MOD03 | ZO1MOD01 | EC0MOD01 |
| 445. | 1.21E-10 | 3 | CCX-PMAMOD1-SW | ED3MOD01 | ED3MOD04 | |
| 446. | 1.20E-10 | 4 | REC-MANDAS | PMA0301ASA | PMAMOD22 | LPM-MAN03 |
| 447. | 1.20E-10 | 4 | REC-MANDAS | PMA0302ASA | PMAMOD21 | LPM-MAN03 |
| 448. | 1.20E-10 | 4 | REC-MANDAS | PMA0301BSA | PMAMOD22 | LPM-MAN03 |
| 449. | 1.20E-10 | 4 | REC-MANDAS | PMA0302BSA | PMAMOD21 | LPM-MAN03 |
| 450. | 1.20E-10 | 4 | MDAS | PMAMOD11 | ZOX-DG-DR | EC0MOD01 |
| 451. | 1.16E-10 | 3 | REC-MANDAS | PMAMOD11 | EC1BS001LF | |
| 452. | 1.14E-10 | 3 | CCX-PMAMOD1 | ED3BSDS1TM | EC1BS001TM | |
| 453. | 1.14E-10 | 3 | CCX-PMAMOD1 | ED3BSDS1TM | EC1BS011TM | |
| 454. | 1.14E-10 | 3 | CCX-PMAMOD1 | ED3BSDS1TM | EC1BS111TM | |
| 455. | 1.12E-10 | 3 | PMA0301ASA | IDAMOD08 | ED3MOD07 | |
| 456. | 1.12E-10 | 3 | PMA0302ASA | IDAMOD04 | ED3MOD07 | |
| 457. | 1.12E-10 | 3 | PMA0301BSA | IDAMOD08 | ED3MOD07 | |
| 458. | 1.12E-10 | 3 | PMA0302BSA | IDAMOD04 | ED3MOD07 | |
| 459. | 1.12E-10 | 4 | MDAS | IDAMOD04 | EC0MOD01 | ED1MOD03 |
| 460. | 1.11E-10 | 4 | MDAS | PMA0301ASA | ECX-CB-GC | EC0MOD01 |
| 461. | 1.11E-10 | 4 | MDAS | PMA0301BSA | ECX-CB-GC | EC0MOD01 |
| 462. | 1.11E-10 | 4 | PMA0301ASA | EC0MOD01 | ED1MOD03 | ED3MOD03 |
| 463. | 1.11E-10 | 4 | PMA0301BSA | EC0MOD01 | ED1MOD03 | ED3MOD03 |
| 464. | 1.09E-10 | 3 | PMAXS00ASA | EC1BS001TM | ED3MOD01 | |
| 465. | 1.06E-10 | 4 | MDAS | IDABSDS1TM | EC0MOD01 | ED1MOD03 |
| 466. | 1.05E-10 | 3 | CCX-PMAMOD1 | CCX-BY-PN1 | EC0MOD01 | |
| 467. | 1.04E-10 | 4 | MDAS | PMA0301ASA | PMAMOD22 | LPM-MAN03 |
| 468. | 1.04E-10 | 4 | MDAS | PMA0302ASA | PMAMOD21 | LPM-MAN03 |
| 469. | 1.04E-10 | 4 | MDAS | PMA0301BSA | PMAMOD22 | LPM-MAN03 |
| 470. | 1.04E-10 | 4 | MDAS | PMA0302BSA | PMAMOD21 | LPM-MAN03 |

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|---|---|---|---|---|---|---|
| 471. | 1.03E-10 | 2 | ALL-IND-FAIL | CCX-INPUT-LOGIC | | |
| 472. | 1.03E-10 | 4 | PMAMOD11 | EC1CB100VO | EC0MOD01 | ED3MOD07 |
| 473. | 1.01E-10 | 4 | PMAMOD11 | EC1CB100VO | EC0MOD01 | ED3BSDS1TM |
| 474. | 1.01E-10 | 4 | CCX-PMAMOD1 | ED3MOD03 | EO1MOD01 | EC0MOD01 |
| 475. | 1.01E-10 | 4 | REC-MANDAS | PMAMOD11 | EC0MOD01 | ED1MOD11 |
| 476. | 1.01E-10 | 4 | REC-MANDAS | PMAMOD11 | EC0MOD01 | ED1MOD113 |
| 477. | 1.01E-10 | 3 | REC-MANDAS | IDAMOD05 | EC1MOD121 | |
| 478. | 1.00E-10 | 3 | MDAS | PMAMOD11 | EC1BS001LF | |
| 479. | 1.00E-10 | 1 | DUMMY | | | |

SUM OF CUTSET PROBABILITIES = 1.488E-05

CUTOFF PROBABILITY = 1.000E-10

C O N F I G U R A T I O N   C O N T R O L   I N F O R M A T I O N

| Code | Version | Configured On | Execution |
|---|---|---|---|
| WLINK | 3.11 | November 19, 1992 | February 15, 1995 |
| Control Number: 23476548857175 | | | @ 12:59:51.27 |

A record of this configuration exists in the Westinghouse Electric Corp.
Engineering Technology Configuration Control Department.

**Table A-2**

Top 200 Cutsets for the IC12A Fault Tree Model

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VER 1.6
 File created by linking ic12a.vlk       WLINK ** Ver. 3.11 **
   72     418  1.481E-05  .00    1.00E-10
                1  ADBEP001BSA           1.7100E-04        .0000E+00
                2  ADBEP011BSA           1.7100E-04        .0000E+00
                3  AND-MAN01             4.9300E-04        .0000E+00
                4  ALL-IND-FAIL          1.0000E-06        .0000E+00
                5  CCX-BY-PM             4.7000E-05        .0000E+00
                6  CCX-BY-PM1            5.7000E-05        .0000E+00
                7  CCX-EP-SAM            8.6200E-06        .0000E+00
                8  CCX-IN-LOGIC-SW       1.1000E-05        .0000E+00
                9  CCX-INPUT-LOGIC       1.0300E-04        .0000E+00
               10  CCX-IV-XR             2.4000E-05        .0000E+00
               11  CCX-PMB030            9.6900E-05        .0000E+00
               12  CCX-PMBMOD1           1.4100E-04        .0000E+00
               13  CCX-PMBMOD1-SW        1.1000E-05        .0000E+00
               14  CCX-PMBMOD2           3.0400E-04        .0000E+00
               15  CCX-PMBMOD2-SW        1.1000E-05        .0000E+00
               16  CCX-PMBMOD4           4.9800E-05        .0000E+00
               17  CCX-SFTW              1.2000E-06        .0000E+00
               18  CCX-XMTR              2.0100E-04        .0000E+00
               19  CMX-VS-FA             3.8400E-05        .0000E+00
               20  DUMMY                 1.0000E-10        .0000E+00
               21  EC0MOD01              1.3100E-02        .0000E+00
               22  EC1BS001TM            2.7000E-03        .0000E+00
               23  EC1BS011TM            2.7000E-03        .0000E+00
               24  EC1BS111TM            2.7000E-03        .0000E+00
               25  EC2BS002LF            4.8000E-06        .0000E+00
               26  EC2BS002TM            2.7000E-03        .0000E+00
               27  EC2BS022TM            2.7000E-03        .0000E+00
               28  EC2BS023TM            2.7000E-03        .0000E+00
               29  EC2BS221TM            2.7000E-03        .0000E+00
               30  EC2CB200VO            1.2300E-02        .0000E+00
               31  EC2MOD22              4.8000E-05        .0000E+00
               32  EC2MOD221             1.6800E-05        .0000E+00
               33  ECX-CB-GC             7.3000E-04        .0000E+00
               34  ECX-CB-GO             1.2000E-03        .0000E+00
               35  ED2MOD03              2.7000E-03        .0000E+00
               36  ED2MOD11              3.1700E-04        .0000E+00
               37  ED3BSDS1TM            3.0000E-04        .0000E+00
               38  ED3MOD01              5.0400E-04        .0000E+00
               39  ED3MOD03              2.7000E-03        .0000E+00
               40  ED3MOD04              2.1900E-02        .0000E+00
               41  ED3MOD07              3.0500E-04        .0000E+00
               42  ED4BSDS1TM            3.0000E-04        .0000E+00
               43  ED4MOD11              3.1700E-04        .0000E+00
               44  ED4MOD112             3.1700E-04        .0000E+00
               45  IDBBSDS1LF            4.8000E-06        .0000E+00
               46  IDBBSDS1TM            3.0000E-04        .0000E+00
               47  IDBMOD10              2.7000E-03        .0000E+00
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| | | | |
|---|---|---|---|
| 48 | IDBMOD11 | 2.7000E-03 | .0000E+00 |
| 49 | IDBMOD24 | 3.1700E-04 | .0000E+00 |
| 50 | IDBMOD25 | 5.1600E-04 | .0000E+00 |
| 51 | IDBMOD26 | 4.3200E-05 | .0000E+00 |
| 52 | IDBMOD27 | 2.1900E-02 | .0000E+00 |
| 53 | IDBMOD36 | 3.1700E-04 | .0000E+00 |
| 54 | LPM-MAN03 | 2.2000E-03 | .0000E+00 |
| 55 | MDAS | 1.0000E-02 | .0000E+00 |
| 56 | PMB0301ASA | 1.1600E-03 | .0000E+00 |
| 57 | PMB0301BSA | 1.1600E-03 | .0000E+00 |
| 58 | PMB0302ASA | 1.1600E-03 | .0000E+00 |
| 59 | PMB0302BSA | 1.1600E-03 | .0000E+00 |
| 60 | PMBMOD11 | 2.0900E-03 | .0000E+00 |
| 61 | PMBMOD12 | 2.0900E-03 | .0000E+00 |
| 62 | PMBMOD21 | 4.0700E-03 | .0000E+00 |
| 63 | PMBMOD22 | 4.0700E-03 | .0000E+00 |
| 64 | PMBXS00ASA | 8.0000E-05 | .0000E+00 |
| 65 | REC-MANDAS | 1.1600E-02 | .0000E+00 |
| 66 | ZO1DG001TM | 4.6000E-02 | .0000E+00 |
| 67 | ZO1MOD01 | 2.0200E-02 | .0000E+00 |
| 68 | ZO2DG002TM | 4.6000E-02 | .0000E+00 |
| 69 | ZO2MOD01 | 2.0200E-02 | .0000E+00 |
| 70 | ZO2MOD04 | 1.2500E-03 | .0000E+00 |
| 71 | ZOX-DG-DR | 4.4000E-04 | .0000E+00 |
| 72 | ZOX-PD-AS | 2.0000E-03 | .0000E+00 |

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|---|---|---|---|---|---|
| 1. | 1.98E-06 | 2 | REC-MANDAS | ADBEP011BSA | |
| 2. | 1.98E-06 | 2 | REC-MANDAS | ADBEP001BSA | |
| 3. | 1.71E-06 | 2 | MDAS | ADBEP011BSA | |
| 4. | 1.71E-06 | 2 | MDAS | ADBEP001BSA | |
| 5. | 1.64E-06 | 2 | REC-MANDAS | CCX-PMBMOD1 | |
| 6. | 1.41E-06 | 2 | MDAS | CCX-PMBMOD1 | |
| 7. | 1.12E-06 | 2 | REC-MANDAS | CCX-PMB030 | |
| 8. | 9.69E-07 | 2 | MDAS | CCX-PMB030 | |
| 9. | 1.28E-07 | 2 | REC-MANDAS | CCX-PMBMOD1-SW | |
| 10. | 1.10E-07 | 2 | MDAS | CCX-PMBMOD1-SW | |
| 11. | 1.00E-07 | 2 | REC-MANDAS | CCX-EP-SAM | |
| 12. | 8.62E-08 | 2 | MDAS | CCX-EP-SAM | |
| 13. | 6.55E-08 | 3 | REC-MANDAS | PMBMOD11 | EC2BS002TM |
| 14. | 6.55E-08 | 3 | REC-MANDAS | PMBMOD11 | EC2BS022TM |
| 15. | 6.55E-08 | 3 | REC-MANDAS | PMBMOD11 | EC2BS221TM |
| 16. | 5.64E-08 | 3 | MDAS | PMBMOD11 | EC2BS002TM |
| 17. | 5.64E-08 | 3 | MDAS | PMBMOD11 | EC2BS022TM |
| 18. | 5.64E-08 | 3 | MDAS | PMBMOD11 | EC2BS221TM |
| 19. | 5.22E-08 | 2 | ADBEP011BSA | ED3MOD07 | |
| 20. | 5.22E-08 | 2 | ADBEP001BSA | ED3MOD07 | |
| 21. | 5.07E-08 | 3 | REC-MANDAS | PMBMOD11 | PMBMOD12 |
| 22. | 4.37E-08 | 3 | MDAS | PMBMOD11 | PMBMOD12 |
| 23. | 4.30E-08 | 2 | CCX-PMBMOD1 | ED3MOD07 | |
| 24. | 3.63E-08 | 3 | REC-MANDAS | PMB0301ASA | EC2BS002TM |
| 25. | 3.63E-08 | 3 | REC-MANDAS | PMB0301ASA | EC2BS022TM |
| 26. | 3.63E-08 | 3 | REC-MANDAS | PMB0301ASA | EC2BS221TM |
| 27. | 3.63E-08 | 3 | REC-MANDAS | PMB0301BSA | EC2BS002TM |
| 28. | 3.63E-08 | 3 | REC-MANDAS | PMB0301BSA | EC2BS022TM |
| 29. | 3.63E-08 | 3 | REC-MANDAS | PMB0301BSA | EC2BS221TM |
| 30. | 3.13E-08 | 3 | MDAS | PMB0301ASA | EC2BS002TM |

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|---|---|---|---|---|---|
| 31. | 3.13E-08 | 3 | MDAS | PMB0301ASA | EC2BS022TM | |
| 32. | 3.13E-08 | 3 | MDAS | PMB0301ASA | EC2BS221TM | |
| 33. | 3.13E-08 | 3 | MDAS | PMB0301BSA | EC2BS002TM | |
| 34. | 3.13E-08 | 3 | MDAS | PMB0301BSA | EC2BS022TM | |
| 35. | 3.13E-08 | 3 | MDAS | PMB0301BSA | EC2BS221TM | |
| 36. | 2.96E-08 | 2 | CCX-PMB030 | ED3MOD07 | | |
| 37. | 2.81E-08 | 3 | REC-MANDAS | PMBMOD12 | PMB0301ASA | |
| 38. | 2.81E-08 | 3 | REC-MANDAS | PMBMOD11 | PMB0302ASA | |
| 39. | 2.81E-08 | 3 | REC-MANDAS | PMB0301BSA | PMBMOD12 | |
| 40. | 2.81E-08 | 3 | REC-MANDAS | PMBMOD11 | PMB0302BSA | |
| 41. | 2.42E-08 | 3 | MDAS | PMBMOD12 | PMB0301ASA | |
| 42. | 2.42E-08 | 3 | MDAS | PMBMOD11 | PMB0302ASA | |
| 43. | 2.42E-08 | 3 | MDAS | PMB0301BSA | PMBMOD12 | |
| 44. | 2.42E-08 | 3 | MDAS | PMBMOD11 | PMB0302BSA | |
| 45. | 1.62E-08 | 3 | REC-MANDAS | IDBMOD25 | EC2BS002TM | |
| 46. | 1.62E-08 | 3 | REC-MANDAS | IDBMOD25 | EC2BS022TM | |
| 47. | 1.62E-08 | 3 | REC-MANDAS | IDBMOD25 | EC2BS221TM | |
| 48. | 1.56E-08 | 3 | REC-MANDAS | PMB0301ASA | PMB0302ASA | |
| 49. | 1.46E-08 | 4 | REC-MANDAS | PMBMOD11 | ZO2DG002TM | EC0MOD01 |
| 50. | 1.39E-08 | 3 | MDAS | IDBMOD25 | EC2BS002TM | |
| 51. | 1.39E-08 | 3 | MDAS | IDBMOD25 | EC2BS022TM | |
| 52. | 1.39E-08 | 3 | MDAS | IDBMOD25 | EC2BS221TM | |
| 53. | 1.39E-08 | 2 | CCX-SFTW | REC-MANDAS | | |
| 54. | 1.35E-08 | 3 | MDAS | PMB0301ASA | PMB0302ASA | |
| 55. | 1.26E-08 | 4 | MDAS | PMBMOD11 | ZO2DG002TM | EC0MOD01 |
| 56. | 1.20E-08 | 2 | CCX-SFTW | MDAS | | |
| 57. | 9.93E-09 | 3 | REC-MANDAS | IDBMOD24 | EC2BS002TM | |
| 58. | 9.93E-09 | 3 | REC-MANDAS | IDBMOD24 | EC2BS022TM | |
| 59. | 9.93E-09 | 3 | REC-MANDAS | IDBMOD24 | EC2BS221TM | |
| 60. | 9.40E-09 | 3 | REC-MANDAS | IDBBSDS1TM | EC2BS002TM | |
| 61. | 9.40E-09 | 3 | REC-MANDAS | IDBBSDS1TM | EC2BS022TM | |
| 62. | 9.40E-09 | 3 | REC-MANDAS | IDBBSDS1TM | EC2BS221TM | |
| 63. | 8.56E-09 | 3 | MDAS | IDBMOD24 | EC2BS002TM | |
| 64. | 8.56E-09 | 3 | MDAS | IDBMOD24 | EC2BS022TM | |
| 65. | 8.56E-09 | 3 | MDAS | IDBMOD24 | EC2BS221TM | |
| 66. | 8.11E-09 | 4 | REC-MANDAS | PMB0301ASA | ZO2DG002TM | EC0MOD01 |
| 67. | 8.11E-09 | 4 | REC-MANDAS | PMB0301BSA | ZO2DG002TM | EC0MOD01 |
| 68. | 8.10E-09 | 3 | MDAS | IDBBSDS1TM | EC2BS002TM | |
| 69. | 8.10E-09 | 3 | MDAS | IDBBSDS1TM | EC2BS022TM | |
| 70. | 8.10E-09 | 3 | MDAS | IDBBSDS1TM | EC2BS221TM | |
| 71. | 7.76E-09 | 3 | REC-MANDAS | CCX-PMBMOD2 | LPM-MAN03 | |
| 72. | 7.72E-09 | 2 | CMX-VS-FA | CCX-XMTR | | |
| 73. | 7.69E-09 | 3 | REC-MANDAS | PMBMOD12 | IDBMOD24 | |
| 74. | 7.69E-09 | 3 | REC-MANDAS | PMBMOD11 | IDBMOD36 | |
| 75. | 6.99E-09 | 4 | MDAS | PMB0301ASA | ZO2DG002TM | EC0MOD01 |
| 76. | 6.99E-09 | 4 | MDAS | PMB0301BSA | ZO2DG002TM | EC0MOD01 |
| 77. | 6.69E-09 | 3 | MDAS | CCX-PMBMOD2 | LPM-MAN03 | |
| 78. | 6.63E-09 | 3 | MDAS | PMBMOD12 | IDBMOD24 | |
| 79. | 6.63E-09 | 3 | MDAS | PMBMOD11 | IDBMOD36 | |
| 80. | 6.42E-09 | 4 | REC-MANDAS | PMBMOD11 | ZO2MOD01 | EC0MOD01 |
| 81. | 5.53E-09 | 4 | MDAS | PMBMOD11 | ZO2MOD01 | EC0MOD01 |
| 82. | 4.27E-09 | 3 | REC-MANDAS | PMB0301ASA | IDBMOD36 | |
| 83. | 4.27E-09 | 3 | REC-MANDAS | PMB0302ASA | IDBMOD24 | |
| 84. | 4.27E-09 | 3 | REC-MANDAS | PMB0301BSA | IDBMOD36 | |
| 85. | 4.27E-09 | 3 | REC-MANDAS | PMB0302BSA | IDBMOD24 | |

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|---|---|---|---|---|---|---|
| 86. | 3.91E-09 | 4 | REC-MANDAS | PMBMOD11 | EC2CB200VO | EC0MOD01 |
| 87. | 3.68E-09 | 3 | MDAS | PMB0301ASA | IDBMOD36 | |
| 88. | 3.68E-09 | 3 | MDAS | PMB0302ASA | IDBMOD24 | |
| 89. | 3.68E-09 | 3 | MDAS | PMB0301BSA | IDBMOD36 | |
| 90. | 3.68E-09 | 3 | MDAS | PMB0302BSA | IDBMOD24 | |
| 91. | 3.61E-09 | 4 | REC-MANDAS | IDBMOD25 | ZO2DG002TM | EC0MOD01 |
| 92. | 3.56E-09 | 4 | REC-MANDAS | PMB0301ASA | ZO2MOD01 | EC0MOD01 |
| 93. | 3.56E-09 | 4 | REC-MANDAS | PMB0301BSA | ZO2MOD01 | EC0MOD01 |
| 94. | 3.37E-09 | 4 | MDAS | PMBMOD11 | EC2CB200VO | EC0MOD01 |
| 95. | 3.36E-09 | 2 | CCX-PMBMOD1-SW | ED3MOD07 | | |
| 96. | 3.11E-09 | 4 | MDAS | IDBMOD25 | ZO2DG002TM | EC0MOD01 |
| 97. | 3.07E-09 | 4 | MDAS | PMB0301ASA | ZO2MOD01 | EC0MOD01 |
| 98. | 3.07E-09 | 4 | MDAS | PMB0301BSA | ZO2MOD01 | EC0MOD01 |
| 99. | 2.63E-09 | 2 | CCX-KP-SAM | ED3MOD07 | | |
| 100. | 2.63E-09 | 3 | REC-MANDAS | CCX-INPUT-LOGIC | LPM-MAN03 | |
| 101. | 2.51E-09 | 3 | REC-MANDAS | PMBXS00ASA | EC2BS002TM | |
| 102. | 2.51E-09 | 3 | REC-MANDAS | PMBXS00ASA | EC2BS022TM | |
| 103. | 2.51E-09 | 3 | REC-MANDAS | PMBXS00ASA | EC2BS221TM | |
| 104. | 2.27E-09 | 3 | MDAS | CCX-INPUT-LOGIC | LPM-MAN03 | |
| 105. | 2.22E-09 | 4 | REC-MANDAS | IDBMOD24 | ZO2DG002TM | EC0MOD01 |
| 106. | 2.17E-09 | 4 | REC-MANDAS | PMB0301ASA | EC2CB200VO | EC0MOD01 |
| 107. | 2.17E-09 | 4 | REC-MANDAS | PMB0301BSA | EC2CB200VO | EC0MOD01 |
| 108. | 2.16E-09 | 3 | MDAS | PMBXS00ASA | EC2BS002TM | |
| 109. | 2.16E-09 | 3 | MDAS | PMBXS00ASA | EC2BS022TM | |
| 110. | 2.16E-09 | 3 | MDAS | PMBXS00ASA | EC2BS221TM | |
| 111. | 2.10E-09 | 4 | REC-MANDAS | IDBBSDS1TM | ZO2DG002TM | EC0MOD01 |
| 112. | 1.94E-09 | 3 | REC-MANDAS | PMBXS00ASA | PMBMOD12 | |
| 113. | 1.94E-09 | 3 | REC-MANDAS | PMBXS00ASA | PMBMOD11 | |
| 114. | 1.91E-09 | 4 | MDAS | IDBMOD24 | ZO2DG002TM | EC0MOD01 |
| 115. | 1.89E-09 | 3 | ADBEP011BSA | ED3MOD01 | ED3MOD04 | |
| 116. | 1.89E-09 | 3 | ADBEP001BSA | ED3MOD01 | ED3MOD04 | |
| 117. | 1.87E-09 | 4 | MDAS | PMB0301ASA | EC2CB200VO | EC0MOD01 |
| 118. | 1.87E-09 | 4 | MDAS | PMB0301BSA | EC2CB200VO | EC0MOD01 |
| 119. | 1.81E-09 | 4 | MDAS | IDBBSDS1TM | ZO2DG002TM | EC0MOD01 |
| 120. | 1.74E-09 | 3 | REC-MANDAS | CCX-PMBMOD2 | AND-MAN01 | |
| 121. | 1.72E-09 | 3 | PMBMOD11 | EC2BS002TM | ED3MOD07 | |
| 122. | 1.72E-09 | 3 | PMBMOD11 | EC2BS022TM | ED3MOD07 | |
| 123. | 1.72E-09 | 3 | PMBMOD11 | EC2BS221TM | ED3MOD07 | |
| 124. | 1.67E-09 | 3 | MDAS | PMBXS00ASA | PMBMOD12 | |
| 125. | 1.67E-09 | 3 | MDAS | PMBXS00ASA | PMBMOD11 | |
| 126. | 1.58E-09 | 4 | REC-MANDAS | IDBMOD25 | ZO2MOD01 | EC0MOD01 |
| 127. | 1.56E-09 | 3 | PMBMOD11 | EC0MOD01 | CCX-BY-PN1 | |
| 128. | 1.56E-09 | 3 | CCX-PMBMOD1 | ED3MOD01 | ED3MOD04 | |
| 129. | 1.50E-09 | 3 | MDAS | CCX-PMBMOD2 | AND-MAN01 | |
| 130. | 1.47E-09 | 3 | REC-MANDAS | CCX-BY-PN | EC2BS002TM | |
| 131. | 1.47E-09 | 3 | REC-MANDAS | CCX-BY-PN | EC2BS022TM | |
| 132. | 1.47E-09 | 3 | REC-MANDAS | CCX-BY-PN | EC2BS221TM | |
| 133. | 1.37E-09 | 4 | MDAS | IDBMOD25 | ZO2MOD01 | EC0MOD01 |
| 134. | 1.33E-09 | 3 | PMBMOD11 | PMBMOD12 | ED3MOD07 | |
| 135. | 1.27E-09 | 3 | MDAS | CCX-BY-PN | EC2BS002TM | |
| 136. | 1.27E-09 | 3 | MDAS | CCX-BY-PN | EC2BS022TM | |
| 137. | 1.27E-09 | 3 | MDAS | CCX-BY-PN | EC2BS221TM | |
| 138. | 1.25E-09 | 3 | ADBEP011BSA | ED3MOD03 | EC1BS001TM | |
| 139. | 1.25E-09 | 3 | ADBEP001BSA | ED3MOD03 | EC1BS001TM | |
| 140. | 1.17E-09 | 3 | REC-MANDAS | IDBMOD24 | IDBMOD36 | |

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| 141. | 1.16E-09 | 3 | REC-MANDAS | PMBMOD11 | EC2MOD22 | |
| 142. | 1.12E-09 | 3 | ADBEF011BSA | ED3MOD04 | ED3BSDS1TM | |
| 143. | 1.12E-09 | 3 | ADBEP001BSA | ED3MOD04 | ED3BSDS1TM | |
| 144. | 1.08E-09 | 3 | REC-MANDAS | PMBXS00ASA | PMB0302ASA | |
| 145. | 1.08E-09 | 3 | REC-MANDAS | PMBXS00ASA | PMB0301ASA | |
| 146. | 1.07E-09 | 3 | CCX-PMB030 | ED3MOD01 | ED3MOD04 | |
| 147. | 1.05E-09 | 3 | REC-MANDAS | PMBMOD11 | IDBMOD26 | |
| 148. | 1.03E-09 | 3 | CCX-PMBMOD1 | ED3MOD03 | EC1BS001TM | |
| 149. | 1.00E-09 | 3 | MDAS | IDBMOD24 | IDBMOD36 | |
| 150. | 1.00E-09 | 3 | MDAS | PMBMOD11 | EC2MOD22 | |
| 151. | 9.80E-10 | 3 | REC-MANDAS | CMX-VS-FA | LPM-MAN03 | |
| 152. | 9.73E-10 | 4 | REC-MANDAS | IDBMOD24 | ZO2MOD01 | EC0MOD01 |
| 153. | 9.64E-10 | 4 | REC-MANDAS | IDBMOD25 | EC2CB200VO | EC0MOD01 |
| 154. | 9.55E-10 | 3 | PMB0301ASA | EC2BS002TM | ED3MOD07 | |
| 155. | 9.55E-10 | 3 | PMB0301ASA | EC2BS022TM | ED3MOD07 | |
| 156. | 9.55E-10 | 3 | PMB0301ASA | EC2BS221TM | ED3MOD07 | |
| 157. | 9.55E-10 | 3 | PMB0301BSA | EC2BS002TM | ED3MOD07 | |
| 158. | 9.55E-10 | 3 | PMB0301BSA | EC2BS022TM | ED3MOD07 | |
| 159. | 9.55E-10 | 3 | PMB0301BSA | EC2BS221TM | ED3MOD07 | |
| 160. | 9.28E-10 | 3 | MDAS | PMBXS00ASA | PMB0302ASA | |
| 161. | 9.28E-10 | 3 | MDAS | PMBXS00ASA | PMB0301ASA | |
| 162. | 9.26E-10 | 3 | CCX-PMBMOD1 | ED3MOD04 | ED3BSDS1TM | |
| 163. | 9.21E-10 | 4 | REC-MANDAS | IDBBSDS1TM | ZO2MOD01 | EC0MOD01 |
| 164. | 9.03E-10 | 3 | MDAS | PMBMOD11 | IDBMOD26 | |
| 165. | 8.66E-10 | 3 | PMB0301ASA | EC0MOD01 | CCX-BY-PN1 | |
| 166. | 8.66E-10 | 3 | PMB0301BSA | EC0MOD01 | CCX-BY-PN1 | |
| 167. | 8.58E-10 | 4 | REC-MANDAS | PMBMOD11 | EC0MOD01 | ED2MOD03 |
| 168. | 8.45E-10 | 3 | MDAS | CMX-VS-FA | LPM-MAN03 | |
| 169. | 8.39E-10 | 4 | MDAS | IDBMOD24 | ZO2MOD01 | EC0MOD01 |
| 170. | 8.31E-10 | 4 | MDAS | IDBMOD25 | EC2CB200VO | EC0MOD01 |
| 171. | 7.94E-10 | 4 | MDAS | IDBBSDS1TM | ZO2MOD01 | EC0MOD01 |
| 172. | 7.52E-10 | 3 | REC-MANDAS | CCX-IV-XR | EC2BS002TM | |
| 173. | 7.52E-10 | 3 | REC-MANDAS | CCX-IV-XR | EC2BS022TM | |
| 174. | 7.52E-10 | 3 | REC-MANDAS | CCX-IV-XR | EC2BS221TM | |
| 175. | 7.39E-10 | 3 | PMBMOD12 | PMB0301ASA | ED3MOD07 | |
| 176. | 7.39E-10 | 3 | PMBMOD11 | PMB0302ASA | ED3MOD07 | |
| 177. | 7.39E-10 | 3 | PMB0301BSA | PMBMOD12 | ED3MOD07 | |
| 178. | 7.39E-10 | 3 | PMBMOD11 | PMB0302BSA | ED3MOD07 | |
| 179. | 7.39E-10 | 4 | MDAS | PMBMOD11 | EC0MOD01 | ED2MOD03 |
| 180. | 7.06E-10 | 3 | CCX-PMB030 | ED3MOD03 | EC1BS001TM | |
| 181. | 6.48E-10 | 3 | MDAS | CCX-IV-XR | EC2BS002TM | |
| 182. | 6.48E-10 | 3 | MDAS | CCX-IV-XR | EC2BS022TM | |
| 183. | 6.48E-10 | 3 | MDAS | CCX-IV-XR | EC2BS221TM | |
| 184. | 6.46E-10 | 3 | REC-MANDAS | PMB0301ASA | EC2MOD22 | |
| 185. | 6.46E-10 | 3 | REC-MANDAS | PMB0301BSA | EC2MOD22 | |
| 186. | 6.37E-10 | 3 | CCX-PMB030 | ED3MOD04 | ED3BSDS1TM | |
| 187. | 6.35E-10 | 4 | REC-MANDAS | PMBMOD11 | ZOX-PD-ES | EC0MOD01 |
| 188. | 5.93E-10 | 4 | REC-MANDAS | IDBMOD24 | EC2CB200VO | EC0MOD01 |
| 189. | 5.89E-10 | 3 | REC-MANDAS | CCX-INPUT-LOGIC | AND-MAN01 | |
| 190. | 5.81E-10 | 3 | REC-MANDAS | PMB0301ASA | IDBMOD26 | |
| 191. | 5.81E-10 | 3 | REC-MANDAS | PMB0301BSA | IDBMOD26 | |
| 192. | 5.61E-10 | 4 | REC-MANDAS | IDBBSDS1TM | EC2CB200VO | EC0MOD01 |
| 193. | 5.59E-10 | 4 | REC-MANDAS | PMBXS00ASA | ZO2DG002TM | EC0MOD01 |
| 194. | 5.57E-10 | 3 | MDAS | PMB0301ASA | EC2MOD22 | |
| 195. | 5.57E-10 | 3 | MDAS | PMB0301BSA | EC2MOD22 | |

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| 196. | 5.48E-10 | 4 | MDAS | PMBMOD11 | ZOX-PD-ES | EC0MOD01 |
| 197. | 5.11E-10 | 4 | MDAS | IDBMOD24 | EC2CB200VO | EC0MOD01 |
| 198. | 5.08E-10 | 3 | MDAS | CCX-INPUT-LOGIC | AND-MAN01 | |
| 199. | 5.01E-10 | 3 | MDAS | PMB0301ASA | IDBMOD26 | |
| 200. | 5.01E-10 | 3 | MDAS | PMB0301BSA | IDBMOD26 | |
| 201. | 4.83E-10 | 4 | MDAS | IDBBSDS1TM | EC2CB200VO | EC0MOD01 |
| 202. | 4.82E-10 | 4 | MDAS | PMBXS00ASA | ZO2DG002TM | EC0MOD01 |
| 203. | 4.76E-10 | 4 | REC-MANDAS | PMB0301ASA | EC0MOD01 | ED2MOD03 |
| 204. | 4.76E-10 | 4 | REC-MANDAS | PMB0301BSA | EC0MOD01 | ED2MOD03 |
| 205. | 4.25E-10 | 3 | IDBMOD25 | EC2BS002TM | ED3MOD07 | |
| 206. | 4.25E-10 | 3 | IDBMOD25 | EC2BS022TM | ED3MOD07 | |
| 207. | 4.25E-10 | 3 | IDBMOD25 | EC2BS221TM | ED3MOD07 | |
| 208. | 4.23E-10 | 4 | REC-MANDAS | PMBMOD22 | PMBMOD21 | LPM-MAN03 |
| 209. | 4.10E-10 | 3 | PMB0301ASA | PMB0302ASA | ED3MOD07 | |
| 210. | 4.10E-10 | 4 | MDAS | PMB0301ASA | EC0MOD01 | ED2MOD03 |
| 211. | 4.10E-10 | 4 | MDAS | PMB0301BSA | EC0MOD01 | ED2MOD03 |
| 212. | 4.07E-10 | 3 | REC-MANDAS | PMBMOD11 | EC2MOD221 | |
| 213. | 3.97E-10 | 4 | REC-MANDAS | PMBMOD11 | ZO2MOD04 | EC0MOD01 |
| 214. | 3.85E-10 | 3 | IDBMOD25 | EC0MOD01 | CCX-BY-PN1 | |
| 215. | 3.84E-10 | 4 | PMBMOD11 | ZO2DG002TM | EC0MOD01 | ED3MOD07 |
| 216. | 3.81E-10 | 4 | REC-MANDAS | PMBMOD11 | ECX-CB-GO | EC0MOD01 |
| 217. | 3.66E-10 | 2 | CCX-SFTW | ED3MOD07 | | |
| 218. | 3.64E-10 | 4 | MDAS | PMBMOD22 | PMBMOD21 | LPM-MAN03 |
| 219. | 3.54E-10 | 4 | REC-MANDAS | PMBMOD11 | ZO2DG002TM | ED4MOD112 |
| 220. | 3.54E-10 | 4 | REC-MANDAS | PMBMOD11 | ZO2DG002TM | ED4MOD11 |
| 221. | 3.53E-10 | 4 | REC-MANDAS | PMB0301ASA | ZOX-PD-ES | EC0MOD01 |
| 222. | 3.53E-10 | 4 | REC-MANDAS | PMB0301BSA | ZOX-PD-ES | EC0MOD01 |
| 223. | 3.51E-10 | 3 | MDAS | PMBMOD11 | EC2MOD221 | |
| 224. | 3.42E-10 | 4 | MDAS | PMBMOD11 | ZO2MOD04 | EC0MOD01 |
| 225. | 3.35E-10 | 4 | REC-MANDAS | PMBMOD11 | ZO2DG002TM | ED4BSDS1TM |
| 226. | 3.29E-10 | 4 | MDAS | PMBMOD11 | ECX-CB-GO | EC0MOD01 |
| 227. | 3.29E-10 | 4 | REC-MANDAS | CCX-BY-PN | ZO2DG002TM | EC0MOD01 |
| 228. | 3.22E-10 | 3 | PMBMOD11 | EC2BS002TM | CCX-BY-PN1 | |
| 229. | 3.22E-10 | 3 | PMBMOD11 | CCX-BY-PN1 | EC2BS023TM | |
| 230. | 3.05E-10 | 4 | MDAS | PMBMOD11 | ZO2DG002TM | ED4MOD112 |
| 231. | 3.05E-10 | 4 | MDAS | PMBMOD11 | ZO2DG002TM | ED4MOD11 |
| 232. | 3.04E-10 | 2 | ALL-IND-FAIL | CCX-PMBMOD2 | | |
| 233. | 3.04E-10 | 4 | MDAS | PMB0301ASA | ZOX-PD-ES | EC0MOD01 |
| 234. | 3.04E-10 | 4 | MDAS | PMB0301BSA | ZOX-PD-ES | EC0MOD01 |
| 235. | 2.94E-10 | 3 | REC-MANDAS | PMBXS00ASA | IDBMOD36 | |
| 236. | 2.94E-10 | 3 | REC-MANDAS | PMBXS60ASA | IDBMOD24 | |
| 237. | 2.88E-10 | 4 | MDAS | PMBMOD11 | ZO2DG002TM | ED4BSDS1TM |
| 238. | 2.87E-10 | 3 | REC-MANDAS | IDBMOD25 | EC2MOD22 | |
| 239. | 2.83E-10 | 4 | MDAS | CCX-BY-PN | ZO2DG002TM | EC0MOD01 |
| 240. | 2.81E-10 | 3 | REC-MANDAS | CCX-IN-LOGIC-SW | LPM-MAN03 | |
| 241. | 2.81E-10 | 3 | REC-MANDAS | CCX-PMBMOD2-SW | LPM-MAN03 | |
| 242. | 2.80E-10 | 4 | REC-MANDAS | PMBMOD21 | LPM-MAN03 | EC2BS002TM |
| 243. | 2.80E-10 | 4 | REC-MANDAS | PMBMOD21 | LPM-MAN03 | EC2BS022TM |
| 244. | 2.80E-10 | 4 | REC-MANDAS | PMBMOD21 | LPM-MAN03 | EC2BS221TM |
| 245. | 2.78E-10 | 4 | ADBEP011BSA | ED3MOD03 | ZO1DG001TM | EC0MOD01 |
| 246. | 2.78E-10 | 4 | ADBEP001BSA | ED3MOD03 | ZO1DG001TM | EC0MOD01 |
| 247. | 2.74E-10 | 4 | REC-MANDAS | PMBMOD12 | IDBMOD25 | IDBMOD27 |
| 248. | 2.61E-10 | 3 | IDBMOD24 | EC2BS002TM | ED3MOD07 | |
| 249. | 2.61E-10 | 3 | IDBMOD24 | EC2BS022TM | ED3MOD07 | |
| 250. | 2.61E-10 | 3 | IDBMOD24 | EC2BS221TM | ED3MOD07 | |

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| 251. | 2.59E-10 | 3 | REC-MANDAS | IDBMOD25 | IDBMOD26 | |
| 252. | 2.54E-10 | 3 | MDAS | PMBXS00ASA | IDBMOD36 | |
| 253. | 2.54E-10 | 3 | MDAS | PMBXS00ASA | IDBMOD24 | |
| 254. | 2.48E-10 | 3 | MDAS | IDBMOD25 | EC2MOD22 | |
| 255. | 2.47E-10 | 3 | IDBBSDS1TM | EC2BS002TM | ED3MOD07 | |
| 256. | 2.47E-10 | 3 | IDBBSDS1TM | EC2BS022TM | ED3MOD07 | |
| 257. | 2.47E-10 | 3 | IDBBSDS1TM | EC2BS221TM | ED3MOD07 | |
| 258. | 2.46E-10 | 4 | REC-MANDAS | PMBXS00ASA | ZO2MOD01 | EC0MOD01 |
| 259. | 2.42E-10 | 3 | MDAS | CCX-IN-LOGIC-SW | LPM-MAN03 | |
| 260. | 2.42E-10 | 3 | MDAS | CCX-PMBMOD2-SW | LPM-MAN03 | |
| 261. | 2.42E-10 | 4 | MDAS | PMBMOD21 | LPM-MAN03 | EC2BS002TM |
| 262. | 2.42E-10 | 4 | MDAS | PMBMOD21 | LPM-MAN03 | EC2BS022TM |
| 263. | 2.42E-10 | 4 | MDAS | PMBMOD21 | LPM-MAN03 | EC2BS221TM |
| 264. | 2.37E-10 | 3 | IDBMOD24 | EC0MOD01 | CCX-BY-PN1 | |
| 265. | 2.36E-10 | 4 | MDAS | PMBMOD12 | IDBMOD25 | IDBMOD27 |
| 266. | 2.33E-10 | 3 | ADBEP011BSA | ED3MOD01 | EC1BS001TM | |
| 267. | 2.33E-10 | 3 | ADBEP011BSA | ED3MOD01 | EC1BS011TM | |
| 268. | 2.33E-10 | 3 | ADBEP011BSA | ED3MOD01 | EC1BS111TM | |
| 269. | 2.33E-10 | 3 | ADBEP001BSA | ED3MOD01 | EC1BS001TM | |
| 270. | 2.33E-10 | 3 | ADBEP001BSA | ED3MOD01 | EC1BS011TM | |
| 271. | 2.33E-10 | 3 | ADBEP001BSA | ED3MOD01 | EC1BS111TM | |
| 272. | 2.32E-10 | 4 | REC-MANDAS | PMBMOD11 | ECX-CB-GC | EC0MOD01 |
| 273. | 2.29E-10 | 4 | CCX-PMBMOD1 | ED3MOD03 | ZO1DG001TM | EC0MOD01 |
| 274. | 2.28E-10 | 4 | REC-MANDAS | IDBMOD10 | IDBMOD11 | EC2BS002TM |
| 275. | 2.28E-10 | 4 | REC-MANDAS | IDBMOD10 | IDBMOD11 | EC2BS022TM |
| 276. | 2.28E-10 | 4 | REC-MANDAS | IDBMOD10 | IDBMOD11 | EC2BS221TM |
| 277. | 2.26E-10 | 3 | REC-MANDAS | PMB0301ASA | EC2MOD221 | |
| 278. | 2.26E-10 | 3 | REC-MANDAS | PMB0301BSA | EC2MOD221 | |
| 279. | 2.24E-10 | 3 | IDBBSDS1TM | EC0MOD01 | CCX-BY-PN1 | |
| 280. | 2.23E-10 | 3 | MDAS | IDBMOD25 | IDBMOD26 | |
| 281. | 2.20E-10 | 4 | REC-MANDAS | PMB0301ASA | ZO2MOD04 | EC0MOD01 |
| 282. | 2.20E-10 | 4 | REC-MANDAS | PMB0301BSA | ZO2MOD04 | EC0MOD01 |
| 283. | 2.20E-10 | 3 | REC-MANDAS | CMX-VS-FA | AND-MAN01 | |
| 284. | 2.17E-10 | 4 | REC-MANDAS | PMBMOD11 | PMBMOD22 | LPM-MAN03 |
| 285. | 2.17E-10 | 4 | REC-MANDAS | PMBMOD12 | PMBMOD21 | LPM-MAN03 |
| 286. | 2.13E-10 | 4 | PMB0301ASA | ZO2DG002TM | EC0MOD01 | ED3MOD07 |
| 287. | 2.13E-10 | 4 | PMB0301BSA | ZO2DG002TM | EC0MOD01 | ED3MOD07 |
| 288. | 2.12E-10 | 4 | REC-MANDAS | IDBMOD25 | EC0MOD01 | ED2MOD03 |
| 289. | 2.12E-10 | 4 | MDAS | PMBXS00ASA | ZO2MOD01 | EC0MOD01 |
| 290. | 2.12E-10 | 4 | REC-MANDAS | PMB0301ASA | ECX-CB-GO | EC0MOD01 |
| 291. | 2.12E-10 | 4 | REC-MANDAS | PMB0301BSA | ECX-CB-GO | EC0MOD01 |
| 292. | 2.04E-10 | 3 | CCX-PMBMOD2 | LPM-MAN03 | ED3MOD07 | |
| 293. | 2.02E-10 | 3 | PMBMOD12 | IDBMOD24 | ED3MOD07 | |
| 294. | 2.02E-10 | 3 | PMBMOD11 | IDBMOD36 | ED3MOD07 | |
| 295. | 2.00E-10 | 4 | MDAS | PMBMOD11 | ECX-CB-GC | EC0MOD01 |
| 296. | 1.97E-10 | 4 | MDAS | IDBMOD10 | IDBMOD11 | EC2BS002TM |
| 297. | 1.97E-10 | 4 | MDAS | IDBMOD10 | IDBMOD11 | EC2BS022TM |
| 298. | 1.97E-10 | 4 | MDAS | IDBMOD10 | IDBMOD11 | EC2BS221TM |
| 299. | 1.96E-10 | 4 | REC-MANDAS | PMB0301ASA | ZO2DG002TM | ED4MOD112 |
| 300. | 1.9[illegible]-10 | 4 | REC-MANDAS | PMB0301ASA | ZO2DG002TM | ED4MOD11 |
| 301. | 1.96E-10 | 4 | REC-MANDAS | PMB0301BSA | ZO2DG002TM | ED4MOD112 |
| 302. | 1.96E-10 | 4 | REC-MANDAS | PMB0301BSA | ZO2DG002TM | ED4MOD11 |
| 303. | 1.95E-10 | 3 | MDAS | PMB0301ASA | EC2MOD221 | |
| 304. | 1.95E-10 | 3 | MDAS | PMB0301BSA | EC2MOD221 | |
| 305. | 1.92E-10 | 3 | CCX-PMBMOD1 | ED3MOD01 | EC1BS001TM | |

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| 306. | 1.92E-10 | 3 | CCX-PMBMOD1 | ED3MOD01 | EC1BS011TM | | |
| 307. | 1.92E-10 | 3 | CCX-PMBMOD1 | ED3MOD01 | EC1BS111TM | | |
| 308. | 1.90E-10 | 4 | MDAS | PMB0301ASA | ZO2MOD04 | EC0MOD01 | |
| 309. | 1.90E-10 | 4 | MDAS | PMB0301BSA | ZO2MOD04 | EC0MOD01 | |
| 310. | 1.89E-10 | 3 | MDAS | CMX-VS-FA | AND-MAN01 | | |
| 311. | 1.87E-10 | 4 | MDAS | PMBMOD11 | PMBMOD22 | LPM-MAN03 | |
| 312. | 1.87E-10 | 4 | MDAS | PMBMOD12 | PMBMOD21 | LPM-MAN03 | |
| 313. | 1.86E-10 | 4 | REC-MANDAS | PMB0301ASA | ZO2DG002TM | ED4BSDS1TM | |
| 314. | 1.86E-10 | 4 | REC-MANDAS | PMB0301BSA | ZO2DG002TM | ED4BSDS1TM | |
| 315. | 1.83E-10 | 4 | MDAS | IDBMOD25 | EC0MOD01 | ED2MOD03 | |
| 316. | 1.82E-10 | 4 | MDAS | PMB0301ASA | ECX-CB-GO | EC0MOD01 | |
| 317. | 1.82E-10 | 4 | MDAS | PMB0301BSA | ECX-CB-GO | EC0MOD01 | |
| 318. | 1.79E-10 | 3 | PMB0301ASA | EC2BS002TM | CCX-BY-PN1 | | |
| 319. | 1.79E-10 | 3 | PMB0301ASA | CCX-BY-PN1 | EC2BS023TM | | |
| 320. | 1.79E-10 | 3 | PMB0301BSA | EC2BS002TM | CCX-BY-PN1 | | |
| 321. | 1.79E-10 | 3 | PMB0301BSA | CCX-BY-PN1 | EC2BS023TM | | |
| 322. | 1.77E-10 | 3 | REC-MANDAS | IDBMOD24 | EC2MOD22 | | |
| 323. | 1.76E-10 | 3 | REC-MANDAS | CCX-PMBMOD2 | CCX-PMBMOD4 | | |
| 324. | 1.71E-10 | 2 | ALL-IND-FAIL | ADBEP011BSA | | | |
| 325. | 1.71E-10 | 2 | ALL-IND-FAIL | ADBEP001BSA | | | |
| 326. | 1.69E-10 | 4 | MDAS | PMB0301ASA | ZO2DG002TM | ED4MOD112 | |
| 327. | 1.69E-10 | 4 | MDAS | PMB0301ASA | ZO2DG002TM | ED4MOD11 | |
| 328. | 1.69E-10 | 4 | MDAS | PMB0301BSA | ZO2DG002TM | ED4MOD112 | |
| 329. | 1.69E-10 | 4 | MDAS | PMB0301BSA | ZO2DG002TM | ED4MOD11 | |
| 330. | 1.69E-10 | 4 | PMBMOD11 | ZO2MOD01 | EC0MOD01 | ED3MOD07 | |
| 331. | 1.68E-10 | 4 | REC-MANDAS | CCX-IV-XR | ZO2DG002TM | EC0MOD01 | |
| 332. | 1.67E-10 | 3 | REC-MANDAS | IDBBSDS1TM | EC2MOD22 | | |
| 333. | 1.60E-10 | 4 | MDAS | PMB0301ASA | ZO2DG002TM | ED4BSDS1TM | |
| 334. | 1.60E-10 | 4 | MDAS | PMB0301BSA | ZO2DG002TM | ED4BSDS1TM | |
| 335. | 1.59E-10 | 4 | REC-MANDAS | PMBMOD12 | IDBMOD27 | IDBBSDS1TM | |
| 336. | 1.59E-10 | 3 | REC-MANDAS | IDBMOD24 | IDBMOD26 | | |
| 337. | 1.58E-10 | 4 | CCX-PMB030 | ED3MOD03 | ZO1DG001TM | EC0MOD01 | |
| 338. | 1.57E-10 | 4 | REC-MANDAS | IDBMOD25 | ZOX-PD-ES | EC0MOD01 | |
| 339. | 1.56E-10 | 5 | PMBMOD11 | ZO2DG002TM | EC0MOD01 | ED3MOD03 | ZO1DG001TM |
| 340. | 1.55E-10 | 4 | REC-MANDAS | PMBMOD11 | ZO2MOD01 | ED4MOD112 | |
| 341. | 1.55E-10 | 4 | REC-MANDAS | PMBMOD11 | ZO2MOD01 | ED4MOD11 | |
| 342. | 1.52E-10 | 3 | MDAS | IDBMOD24 | EC2MOD22 | | |
| 343. | 1.52E-10 | 4 | REC-MANDAS | PMB0302ASA | IDBMOD25 | IDBMOD27 | |
| 344. | 1.52E-10 | 4 | REC-MANDAS | PMB0302BSA | IDBMOD25 | IDBMOD27 | |
| 345. | 1.51E-10 | 3 | MDAS | CCX-PMBMOD2 | CCX-PMBMOD4 | | |
| 346. | 1.50E-10 | 3 | REC-MANDAS | IDBBSDS1LF | EC2BS002TM | | |
| 347. | 1.50E-10 | 3 | REC-MANDAS | IDBBSDS1LF | EC2BS022TM | | |
| 348. | 1.50E-10 | 3 | REC-MANDAS | IDBBSDS1LF | EC2BS221TM | | |
| 349. | 1.50E-10 | 3 | REC-MANDAS | IDBMOD26 | IDBBSDS1TM | | |
| 350. | 1.50E-10 | 4 | REC-MANDAS | PMBXS00ASA | EC2CB200VO | EC0MOD01 | |
| 351. | 1.48E-10 | 4 | PMBMOD11 | ZOX-PD-ES | EC0MOD01 | ED3MOD03 | |
| 352. | 1.47E-10 | 4 | REC-MANDAS | PMBMOD11 | ZO2MOD01 | ED4BSDS1TM | |
| 353. | 1.45E-10 | 4 | MDAS | CCX-IV-XR | ZO2DG002TM | EC0MOD01 | |
| 354. | 1.44E-10 | 4 | REC-MANDAS | CCX-BY-PN | ZO2MOD01 | EC0MOD01 | |
| 355. | 1.44E-10 | 3 | MDAS | IDBBSDS1TM | EC2MOD22 | | |
| 356. | 1.41E-10 | 2 | ALL-IND-FAIL | CCX-PMBMOD1 | | | |
| 357. | 1.40E-10 | 4 | REC-MANDAS | PMBMOD11 | ZOX-DG-DR | EC0MOD01 | |
| 358. | 1.39E-10 | 3 | ADBEP011BSA | ED3BSDS1TM | EC1BS001TM | | |
| 359. | 1.39E-10 | 3 | ADBEP011BSA | ED3BSDS1TM | EC1BS011TM | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 360. | 1.39E-10 | 3 | ADSEP011BSA | ED3BSDS1TM | EC1BS111TM | |
| 361. | 1.39E-10 | 3 | ADSEP001BSA | ED3BSDS1TM | EC1BS001TM | |
| 362. | 1.39E-10 | 3 | ADSEP001BSA | ED3BSDS1TM | EC1BS011TM | |
| 363. | 1.39E-10 | 3 | ADSEP001BSA | ED3BSDS1TM | EC1BS111TM | |
| 364. | 1.37E-10 | 4 | MDAS | PMBMOD12 | IDBMOD27 | IDBBSDS1TM |
| 365. | 1.37E-10 | 3 | MDAS | IDBMOD24 | IDBMOD26 | |
| 366. | 1.35E-10 | 4 | MDAS | IDBMOD25 | ZOX-PD-ES | EC0MOD01 |
| 367. | 1.34E-10 | 4 | MDAS | PMBMOD11 | ZO2MOD01 | ED4MOD112 |
| 368. | 1.34E-10 | 4 | MDAS | PMBMOD11 | ZO2MOD01 | ED4MOD11 |
| 369. | 1.32E-10 | 3 | CCX-PMB030 | ED3MOD01 | EC1BS001TM | |
| 370. | 1.32E-10 | 3 | CCX-PMB030 | ED3MOD01 | EC1BS011TM | |
| 371. | 1.32E-10 | 3 | CCX-PMB030 | ED3MOD01 | EC1BS111TM | |
| 372. | 1.31E-10 | 4 | MDAS | PMB0302ASA | IDBMOD25 | IDBMOD27 |
| 373. | 1.31E-10 | 4 | MDAS | PMB0302BSA | IDBMOD25 | IDBMOD27 |
| 374. | 1.30E-10 | 4 | REC-MANDAS | IDBMOD24 | EC0MOD01 | ED2MOD03 |
| 375. | 1.30E-10 | 3 | MDAS | IDBBSDS1LF | EC2BS002TM | |
| 376. | 1.30E-10 | 3 | MDAS | IDBBSDS1LF | EC2BS022TM | |
| 377. | 1.30E-10 | 3 | MDAS | IDBBSDS1LF | EC2BS221TM | |
| 378. | 1.30E-10 | 3 | MDAS | IDBMOD26 | IDBBSDS1TM | |
| 379. | 1.29E-10 | 4 | MDAS | PMBXS00ASA | EC2CB200VO | EC0MOD01 |
| 380. | 1.29E-10 | 4 | REC-MANDAS | PMB0301ASA | ECX-CB-GC | EC0MOD01 |
| 381. | 1.29E-10 | 4 | REC-MANDAS | PMB0301BSA | ECX-CB-GC | EC0MOD01 |
| 382. | 1.28E-10 | 3 | ADSEP011BSA | CCX-BY-PN1 | EC0MOD01 | |
| 383. | 1.28E-10 | 3 | ADSEP001BSA | CCX-BY-PN1 | EC0MOD01 | |
| 384. | 1.27E-10 | 4 | MDAS | PMBMOD11 | ZO2MOD01 | ED4BSDS1TM |
| 385. | 1.24E-10 | 4 | MDAS | CCX-BY-PN | ZO2MOD01 | EC0MOD01 |
| 386. | 1.23E-10 | 4 | REC-MANDAS | IDBBSDS1TM | EC0MOD01 | ED2MOD03 |
| 387. | 1.22E-10 | 4 | ADSEP011BSA | ED3MOD03 | ZO1MOD01 | EC0MOD01 |
| 388. | 1.22E-10 | 4 | ADSEP001BSA | ED3MOD03 | ZO1MOD01 | EC0MOD01 |
| 389. | 1.21E-10 | 3 | CCX-PMBMOD1-SW | ED3MOD01 | ED3MOD04 | |
| 390. | 1.20E-10 | 4 | REC-MANDAS | PMB0301ASA | PMBMOD22 | LPM-MAN03 |
| 391. | 1.20E-10 | 4 | REC-MANDAS | PMB0302ASA | PMBMOD21 | LPM-MAN03 |
| 392. | 1.20E-10 | 4 | REC-MANDAS | PMB0301BSA | PMBMOD22 | LPM-MAN03 |
| 393. | 1.20E-10 | 4 | REC-MANDAS | PMB0302BSA | PMBMOD21 | LPM-MAN03 |
| 394. | 1.20E-10 | 4 | MDAS | PMBMOD11 | ZOX-DG-DR | EC0MOD01 |
| 395. | 1.16E-10 | 3 | REC-MANDAS | PMBMOD11 | EC2BS002LF | |
| 396. | 1.14E-10 | 3 | CCX-PMBMOD1 | ED3BSDS1TM | EC1BS001TM | |
| 397. | 1.14E-10 | 3 | CCX-PMBMOD1 | ED3BSDS1TM | EC1BS011TM | |
| 398. | 1.14E-10 | 3 | CCX-PMBMOD1 | ED3BSDS1TM | EC1BS111TM | |
| 399. | 1.12E-10 | 3 | PMB0301ASA | IDBMOD36 | ED3MOD07 | |
| 400. | 1.12E-10 | 3 | PMB0302ASA | IDBMOD24 | ED3MOD07 | |
| 401. | 1.12E-10 | 3 | PMB0301BSA | IDBMOD36 | ED3MOD07 | |
| 402. | 1.12E-10 | 3 | PMB0302BSA | IDBMOD24 | ED3MOD07 | |
| 403. | 1.12E-10 | 4 | MDAS | IDBMOD24 | EC0MOD01 | ED2MOD03 |
| 404. | 1.11E-10 | 4 | MDAS | PMB0301ASA | ECX-CB-GC | EC0MOD01 |
| 405. | 1.11E-10 | 4 | MDAS | PMB0301BSA | ECX-CB-GC | EC0MOD01 |
| 406. | 1.06E-10 | 4 | MDAS | IDBBSDS1TM | EC0MOD01 | ED2MOD03 |
| 407. | 1.05E-10 | 3 | CCX-PMBMOD1 | CCX-BY-PN1 | EC0MOD01 | |
| 408. | 1.04E-10 | 4 | MDAS | PMB0301ASA | PMBMOD22 | LPM-MAN03 |
| 409. | 1.04E-10 | 4 | MDAS | PMB0302ASA | PMBMOD21 | LPM-MAN03 |
| 410. | 1.04E-10 | 4 | MDAS | PMB0301BSA | PMBMOD22 | LPM-MAN03 |
| 411. | 1.04E-10 | 4 | MDAS | PMB0302BSA | PMBMOD21 | LPM-MAN03 |
| 412. | 1.03E-10 | 2 | ALL-IND-FAIL | CCX-INPUT-LOGIC | | |
| 413. | 1.03E-10 | 4 | PMBMOD11 | EC2CB200VO | EC0MOD01 | ED3MOD07 |
| 414. | 1.01E-10 | 4 | CCX-PMBMOD1 | ED3MOD03 | ZO1MOD01 | EC0MOD01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 415. | 1.01E-10 | 4 | REC-NANDAS | PMBMOD11 | EC0MOD01 | ED2MOD11 |
| 416. | 1.01E-10 | 3 | REC-NANDAS | IDBMOD25 | EC2MOD221 | |
| 417. | 1.00E-10 | 3 | MDAS | PMBMOD11 | EC2BS002LF | |
| 418. | 1.00E-10 | 1 | DUMMY | | | |

SUM OF CUTSET PROBABILITIES = 1.681E-05

CUTOFF PROBABILITY = 1.000E-10

C O N F I G U R A T I O N   C O N T R O L   I N F O R M A T I O N

| Code | Version | Configured On | Execution |
|---|---|---|---|
| WLINK | 3.11 | November 19, 1992 | February 15, 1995 |
| Control Number: 7175242736485 | | | @ 13:15:48.01 |

A record of this configuration exists in the Westinghouse Electric Corp.
Engineering Technology Configuration Control Department.

**Table A-3**
List of Results for Each I&C Model

```
Fault Tree Name:         cas-ic1.wlk
Fault Tree Result:       6.966E-04
Number of Cutsets:       832
Number of Basic Events:  95

Fault Tree Name:         cas-ic2.wlk
Fault Tree Result:       5.855E-03
Number of Cutsets:       875
Number of Basic Events:  86

Fault Tree Name:         cas-ic1p.wlk
Fault Tree Result:       1.508E-03
Number of Cutsets:       700
Number of Basic Events:  88

Fault Tree Name:         cas-ic2p.wlk
Fault Tree Result:       6.759E-03
Number of Cutsets:       600
Number of Basic Events:  79

Fault Tree Name:         cas-ic3.wlk
Fault Tree Result:       5.855E-03
Number of Cutsets:       875
Number of Basic Events:  86

Fault Tree Name:         cas-ic3p.wlk
Fault Tree Result:       6.759E-03
Number of Cutsets:       600
Number of Basic Events:  79

Fault Tree Name:         cas-ic4p.wlk
Fault Tree Result:       1.337E-03
Number of Cutsets:       699
Number of Basic Events:  87

Fault Tree Name:         cas-ic5.wlk
Fault Tree Result:       1.605E-02
Number of Cutsets:       457
Number of Basic Events:  79

Fault Tree Name:         ccs-ic1.wlk
Fault Tree Result:       5.720E-04
Number of Cutsets:       719
Number of Basic Events:  101

Fault Tree Name:         ccs-ic2p.wlk
Fault Tree Result:       4.061E-03
Number of Cutsets:       673
Number of Basic Events:  93

Fault Tree Name:         ccs-ic3.wlk
Fault Tree Result:       5.720E-04
Number of Cutsets:       719
```

Number of Basic Events: 101

Fault Tree Name: ccs-ic3p.wlk
Fault Tree Result: 4.054E-03
Number of Cutsets: 620
Number of Basic Events: 93

Fault Tree Name: CDs-ic1.wlk
Fault Tree Result: 5.901E-03
Number of Cutsets: 653
Number of Basic Events: 76

Fault Tree Name: CDs-ic2.wlk
Fault Tree Result: 5.901E-03
Number of Cutsets: 653
Number of Basic Events: 76

Fault Tree Name: CDs-ic3.wlk
Fault Tree Result: 5.901E-03
Number of Cutsets: 653
Number of Basic Events: 76

Fault Tree Name: cis-ic1.wlk
Fault Tree Result: 7.042E-04
Number of Cutsets: 727
Number of Basic Events: 92

Fault Tree Name: cis-ic2.wlk
Fault Tree Result: 2.013E-04
Number of Cutsets: 200
Number of Basic Events: 46

Fault Tree Name: cis-ic3.wlk
Fault Tree Result: 2.013E-04
Number of Cutsets: 140
Number of Basic Events: 43

Fault Tree Name: cis-ic4.wlk
Fault Tree Result: 2.013E-04
Number of Cutsets: 200
Number of Basic Events: 46

Fault Tree Name: cis-ic5.wlk
Fault Tree Result: 2.013E-04
Number of Cutsets: 140
Number of Basic Events: 43

Fault Tree Name: cis-ic6.wlk
Fault Tree Result: 2.013E-04
Number of Cutsets: 200
Number of Basic Events: 46

Fault Tree Name: cis-ic7.wlk
Fault Tree Result: 2.013E-04
Number of Cutsets: 140
Number of Basic Events: 43

Fault Tree Name: cis-ic8.wlk
Fault Tree Result: 2.013E-04
Number of Cutsets: 200
Number of Basic Events: 46

Fault Tree Name: cis-ic9.wlk
Fault Tree Result: 2.013E-04
Number of Cutsets: 140
Number of Basic Events: 43

Fault Tree Name: cmt-ic1.wlk
Fault Tree Result: 4.193E-07
Number of Cutsets: 210
Number of Basic Events: 51

Fault Tree Name: cmt-ic2.wlk
Fault Tree Result: 4.193E-07
Number of Cutsets: 210
Number of Basic Events: 51

Fault Tree Name: cmt-ic3.wlk
Fault Tree Result: 3.456E-07
Number of Cutsets: 149
Number of Basic Events: 47

Fault Tree Name: cmt-ic4.wlk
Fault Tree Result: 3.456E-07
Number of Cutsets: 149
Number of Basic Events: 47

Fault Tree Name: cmt-ic5.wlk
Fault Tree Result: 4.205E-07
Number of Cutsets: 214
Number of Basic Events: 51

Fault Tree Name: cmt-ic6.wlk
Fault Tree Result: 4.205E-07
Number of Cutsets: 214
Number of Basic Events: 51

Fault Tree Name: cmt-ic7.wlk
Fault Tree Result: 4.475E-07
Number of Cutsets: 248
Number of Basic Events: 54

Fault Tree Name: cmt-ic8.wlk
Fault Tree Result: 4.475E-07
Number of Cutsets: 248
Number of Basic Events: 54

Fault Tree Name: cmt-ic9.wlk
Fault Tree Result: 3.691E-07
Number of Cutsets: 178
Number of Basic Events: 51

Fault Tree Name: cmt-ic10.wlk

```
Fault Tree Result:        3.691E-07
Number of Cutsets:        178
Number of Basic Events:   51

Fault Tree Name:          cmt-ic11.wlk
Fault Tree Result:        4.193E-07
Number of Cutsets:        210
Number of Basic Events:   51

Fault Tree Name:          cmt-ic12.wlk
Fault Tree Result:        4.193E-07
Number of Cutsets:        210
Number of Basic Events:   51

Fault Tree Name:          cmt-ic13.wlk
Fault Tree Result:        3.456E-07
Number of Cutsets:        149
Number of Basic Events:   47

Fault Tree Name:          cmt-ic14.wlk
Fault Tree Result:        3.456E-07
Number of Cutsets:        149
Number of Basic Events:   47

Fault Tree Name:          cmt-ic15.wlk
Fault Tree Result:        3.466E-07
Number of Cutsets:        152
Number of Basic Events:   47

Fault Tree Name:          cmt-ic16.wlk
Fault Tree Result:        3.466E-07
Number of Cutsets:        152
Number of Basic Events:   47

Fault Tree Name:          cmt-ic17.wlk
Fault Tree Result:        7.260E-07
Number of Cutsets:        478
Number of Basic Events:   62

Fault Tree Name:          cmt-ic18.wlk
Fault Tree Result:        7.260E-07
Number of Cutsets:        478
Number of Basic Events:   62

Fault Tree Name:          cmt-ic19.wlk
Fault Tree Result:        6.246E-07
Number of Cutsets:        369
Number of Basic Events:   62

Fault Tree Name:          cmt-ic20.wlk
Fault Tree Result:        6.246E-07
Number of Cutsets:        369
Number of Basic Events:   62

Fault Tree Name:          cmt-ic21.wlk
Fault Tree Result:        4.205E-07
```

```
Number of Cutsets:       214
Number of Basic Events: 51

Fault Tree Name:         cmt-ic22.wlk
Fault Tree Result:       4.205E-07
Number of Cutsets:       214
Number of Basic Events: 51

Fault Tree Name:         cmt-ic23.wlk
Fault Tree Result:       3.466E-07
Number of Cutsets:       152
Number of Basic Events: 47

Fault Tree Name:         cmt-ic24.wlk
Fault Tree Result:       3.466E-07
Number of Cutsets:       152
Number of Basic Events: 47

Fault Tree Name:         cvs-ic1.wlk
Fault Tree Result:       8.400E-04
Number of Cutsets:       697
Number of Basic Events: 79

Fault Tree Name:         cvs-ic2.wlk
Fault Tree Result:       8.400E-04
Number of Cutsets:       697
Number of Basic Events: 79

Fault Tree Name:         cvs-ic3.wlk
Fault Tree Result:       1.195E-03
Number of Cutsets:       814
Number of Basic Events: 104

Fault Tree Name:         cvs-ic4.wlk
Fault Tree Result:       7.776E-04
Number of Cutsets:       737
Number of Basic Events: 77

Fault Tree Name:         cvs-ic5.wlk
Fault Tree Result:       7.776E-04
Number of Cutsets:       706
Number of Basic Ev   s: 76

Fault Tree Name:         cvs-ic6.wlk
Fault Tree Result:       9.824E-04
Number of Cutsets:       684
Number of Basic Events: 89

Fault Tree Name:         cvs-ic7.wlk
Fault Tree Result:       9.824E-04
Number of Cutsets:       713
Number of Basic Events: 90

Fault Tree Name:         cvs-ic8.wlk
Fault Tree Result:       9.824E-04
Number of Cutsets:       713
```

Number of Basic Events: 90

Fault Tree Name: cvs-ic9.wlk
Fault Tree Result: 1.048E-03
Number of Cutsets: 648
Number of Basic Events: 87

Fault Tree Name: cvs-ic10.wlk
Fault Tree Result: 1.048E-03
Number of Cutsets: 648
Number of Basic Events: 87

Fault Tree Name: cvs-ic11.wlk
Fault Tree Result: 4.843E-04
Number of Cutsets: 4
Number of Basic Events: 4

Fault Tree Name: ecs-ic1b.wlk
Fault Tree Result: 8.314E-05
Number of Cutsets: 20
Number of Basic Events: 21

Fault Tree Name: ecs-ic2b.wlk
Fault Tree Result: 8.314E-05
Number of Cutsets: 20
Number of Basic Events: 21

Fault Tree Name: ecs-ic3b.wlk
Fault Tree Result: 1.319E-02
Number of Cutsets: 60
Number of Basic Events: 33

Fault Tree Name: ecs-ic4b.wlk
Fault Tree Result: 1.319E-02
Number of Cutsets: 60
Number of Basic Events: 33

Fault Tree Name: ic11a.wlk
Fault Tree Result: 1.488E-05
Number of Cutsets: 479
Number of Basic Events: 72

Fault Tree Name: ic11ab.wlk
Fault Tree Result: 6.057E-03
Number of Cutsets: 35
Number of Basic Events: 30

Fault Tree Name: ic11al.wlk
Fault Tree Result: 1.493E-05
Number of Cutsets: 483
Number of Basic Events: 72

Fault Tree Name: ic11ap.wlk
Fault Tree Result: 2.584E-05
Number of Cutsets: 830
Number of Basic Events: 85

```
Fault Tree Name:          ic11epo.wlk
Fault Tree Result:        7.806E-06
Number of Cutsets:        353
Number of Basic Events:   64

Fault Tree Name:          ic11m.wlk
Fault Tree Result:        1.849E-03
Number of Cutsets:        684
Number of Basic Events:   93

Fault Tree Name:          ic11mb.wlk
Fault Tree Result:        8.957E-02
Number of Cutsets:        21
Number of Basic Events:   23

Fault Tree Name:          ic11ml.wlk
Fault Tree Result:        1.849E-03
Number of Cutsets:        684
Number of Basic Events:   93

Fault Tree Name:          ic11mp.wlk
Fault Tree Result:        1.861E-03
Number of Cutsets:        1064
Number of Basic Events:   100

Fault Tree Name:          ic12a.wlk
Fault Tree Result:        1.481E-05
Number of Cutsets:        418
Number of Basic Events:   72

Fault Tree Name:          ic12ab.wlk
Fault Tree Result:        6.057E-03
Number of Cutsets:        35
Number of Basic Events:   30

Fault Tree Name:          ic12al.wlk
Fault Tree Result:        1.486E-05
Number of Cutsets:        421
Number of Basic Events:   72

Fault Tree Name:          ic12ap.wlk
Fault Tree Result:        2.574E-05
Number of Cutsets:        773
Number of Basic Events:   86

Fault Tree Name:          ic12epo.wlk
Fault Tree Result:        7.724E-06
Number of Cutsets:        282
Number of Basic Events:   65

Fault Tree Name:          ic12m.wlk
Fault Tree Result:        1.849E-03
Number of Cutsets:        612
Number of Basic Events:   100

Fault Tree Name:          ic12mb.wlk
```

```
Fault Tree Result:       8.957E-02
Number of Cutsets:       21
Number of Basic Events:  23

Fault Tree Name:         ic12ml.wlk
Fault Tree Result:       1.849E-03
Number of Cutsets:       612
Number of Basic Events:  100

Fault Tree Name:         ic12mp.wlk
Fault Tree Result:       1.861E-03
Number of Cutsets:       993
Number of Basic Events:  111

Fault Tree Name:         ic21a.wlk
Fault Tree Result:       1.501E-05
Number of Cutsets:       500
Number of Basic Events:  75

Fault Tree Name:         ic21ab.wlk
Fault Tree Result:       6.057E-03
Number of Cutsets:       35
Number of Basic Events:  30

Fault Tree Name:         ic21al.wlk
Fault Tree Result:       1.523E-05
Number of Cutsets:       504
Number of Basic Events:  75

Fault Tree Name:         ic21ap.wlk
Fault Tree Result:       2.584E-05
Number of Cutsets:       830
Number of Basic Events:  85

Fault Tree Name:         ic21m.wlk
Fault Tree Result:       1.849E-03
Number of Cutsets:       684
Number of Basic Events:  93

Fault Tree Name:         ic21mb.wlk
Fault Tree Result:       8.957E-02
Number of Cutsets:       21
Number of Basic Events:  23

Fault Tree Name:         ic21ml.wlk
Fault Tree Result:       1.849E-03
Number of Cutsets:       684
Number of Basic Events:  93

Fault Tree Name:         ic21mp.wlk
Fault Tree Result:       1.861E-03
Number of Cutsets:       1064
Number of Basic Events:  100

Fault Tree Name:         ic22a.wlk
Fault Tree Result:       1.494E-05
```

```
Number of Cutsets:        439
Number of Basic Events:  75

Fault Tree Name:          ic22ab.wlk
Fault Tree Result:        6.057E-03
Number of Cutsets:        35
Number of Basic Events:  30

Fault Tree Name:          ic22al.wlk
Fault Tree Result:        1.515E-05
Number of Cutsets:        442
Number of Basic Events:  75

Fault Tree Name:          ic22ap.wlk
Fault Tree Result:        2.574E-05
Number of Cutsets:        773
Number of Basic Events:  86

Fault Tree Name:          ic22m.wlk
Fault Tree Result:        1.84[illegible]E-03
Number of Cutsets:        612
Number of Basic Events:  100

Fault Tree Name:          ic22mb.wlk
Fault Tree Result:        8.957E-02
Number of Cutsets:        21
Number of Basic Events:  23

Fault Tree Name:          ic22ml.wlk
Fault Tree Result:        1.849E-03
Number of Cutsets:        612
Number of Basic Events:  100

Fault Tree Name:          ic22mp.wlk
Fault Tree Result:        1.861E-03
Number of Cutsets:        993
Number of Basic Events:  111

Fault Tree Name:          ic31a.wlk
Fault Tree Result:        1.488E-05
Number of Cutsets:        479
Number of Basic Events:  72

Fault Tree Name:          ic31ab.wlk
Fault Tree Result:        6.057E-03
Number of Cutsets:        35
Number of Basic Events:  30

Fault Tree Name:          ic31al.wlk
Fault Tree Result:        1.493E-05
Number of Cutsets:        483
Number of Basic Events:  72

Fault Tree Name:          ic31ap.wlk
Fault Tree Result:        2.584E-05
Number of Cutsets:        830
```

```
Number of Basic Events: 85

Fault Tree Name:        ic31m.wlk
Fault Tree Result:      1.849E-03
Number of Cutsets:      684
Number of Basic Events: 93

Fault Tree Name:        ic31mb.wlk
Fault Tree Result:      8.957E-02
Number of Cutsets:      21
Number of Basic Events: 23

Fault Tree Name:        ic31ml.wlk
Fault Tree Result:      1.849E-03
Number of Cutsets:      684
Number of Basic Events: 93

Fault Tree Name:        ic31mp.wlk
Fault Tree Result:      1.861E-03
Number of Cutsets:      1064
Number of Basic Events: 100

Fault Tree Name:        ic32a.wlk
Fault Tree Result:      1.481E-05
Number of Cutsets:      418
Number of Basic Events: 72

Fault Tree Name:        ic32ab.wlk
Fault Tree Result:      6.057E-03
Number of Cutsets:      35
Number of Basic Events: 30

Fault Tree Name:        ic32al.wlk
Fault Tree Result:      1.486E-05
Number of Cutsets:      421
Number of Basic Events: 72

Fault Tree Name:        ic32ap.wlk
Fault Tree Result:      2.574E-05
Number of Cutsets:      773
Number of Basic Events: 86

Fault Tree Name:        ic32m.wlk
Fault Tree Result:      1.849E-03
Number of Cutsets:      612
Number of Basic Events: 100

Fault Tree Name:        ic32mb.wlk
Fault Tree Result:      8.957E-02
Number of Cutsets:      21
Number of Basic Events: 23

Fault Tree Name:        ic32ml.wlk
Fault Tree Result:      1.849E-03
Number of Cutsets:      612
Number of Basic Events: 100
```

Fault Tree Name: ic32mp.wlk
Fault Tree Result: 1.861E-03
Number of Cutsets: 993
Number of Basic Events: 111

Fault Tree Name: ic41a.wlk
Fault Tree Result: 1.488E-05
Number of Cutsets: 479
Number of Basic Events: 72

Fault Tree Name: ic41ab.wlk
Fault Tree Result: 6.057E-03
Number of Cutsets: 35
Number of Basic Events: 30

Fault Tree Name: ic41al.wlk
Fault Tree Result: 1.493E-05
Number of Cutsets: 483
Number of Basic Events: 72

Fault Tree Name: ic41ap.wlk
Fault Tree Result: 2.584E-05
Number of Cutsets: 830
Number of Basic Events: 85

Fault Tree Name: ic41m.wlk
Fault Tree Result: 1.849E-03
Number of Cutsets: 684
Number of Basic Events: 93

Fault Tree Name: ic41mb.wlk
Fault Tree Result: 8.957E-02
Number of Cutsets: 21
Number of Basic Events: 23

Fault Tree Name: ic41ml.wlk
Fault Tree Result: 1.849E-03
Number of Cutsets: 684
Number of Basic Events: 93

Fault Tree Name: ic41mp.wlk
Fault Tree Result: 1.861E-03
Number of Cutsets: 1064
Number of Basic Events: 100

Fault Tree Name: ic41mq.wlk
Fault Tree Result: 2.210E-03
Number of Cutsets: 750
Number of Basic Events: 89

Fault Tree Name: ic41mt.wlk
Fault Tree Result: 2.210E-03
Number of Cutsets: 750
Number of Basic Events: 89

Fault Tree Name: ic41mw.wlk

```
Fault Tree Result:       1.848E-03
Number of Cutsets:       222
Number of Basic Events: 56

Fault Tree Name:         ic41mwp.wlk
Fault Tree Result:       8.857E-05
Number of Cutsets:       428
Number of Basic Events: 66

Fault Tree Name:         ic42a.wlk
Fault Tree Result:       1.481E-05
Number of Cutsets:       418
Number of Basic Events: 72

Fault Tree Name:         ic42ab.wlk
Fault Tree Result:       6.057E-03
Number of Cutsets:       35
Number of Basic Events: 30

Fault Tree Name:         ic42al.wlk
Fault Tree Result:       1.486E-05
Number of Cutsets:       421
Number of Basic Events: 72

Fault Tree Name:         ic42ap.wlk
Fault Tree Result:       2.574E-05
Number of Cutsets:       773
Number of Basic Events: 86

Fault Tree Name:         ic42m.wlk
Fault Tree Result:       1.849E-03
Number of Cutsets:       612
Number of Basic Events: 100

Fault Tree Name:         ic42mb.wlk
Fault Tree Result:       8.957E-02
Number of Cutsets:       21
Number of Basic Events: 23

Fault Tree Name:         ic42ml.wlk
Fault Tree Result:       1.849E-03
Number of Cutsets:       612
Number of Basic Events: 100

Fault Tree Name:         ic42mp.wlk
Fault Tree Result:       1.861E-03
Number of Cutsets:       993
Number of Basic Events: 111

Fault Tree Name:         ic42mq.wlk
Fault Tree Result:       2.210E-03
Number of Cutsets:       678
Number of Basic Events: 96

Fault Tree Name:         ic42mt.wlk
Fault Tree Result:       2.210E-03
```

Number of Cutsets: 678
Number of Basic Events: 96

Fault Tree Name: ic42mw.wlk
Fault Tree Result: 1.849E-03
Number of Cutsets: 612
Number of Basic Events: 100

Fault Tree Name: ic42mwp.wlk
Fault Tree Result: 8.873E-05
Number of Cutsets: 890
Number of Basic Events: 89

Fault Tree Name: ic43a.wlk
Fault Tree Result: 1.488E-05
Number of Cutsets: 479
Number of Basic Events: 72

Fault Tree Name: ic43ab.wlk
Fault Tree Result: 6.057E-03
Number of Cutsets: 35
Number of Basic Events: 30

Fault Tree Name: ic43al.wlk
Fault Tree Result: 1.493E-05
Number of Cutsets: 483
Number of Basic Events: 72

Fault Tree Name: ic43ap.wlk
Fault Tree Result: 2.584E-05
Number of Cutsets: 830
Number of Basic Events: 85

Fault Tree Name: ic43m.wlk
Fault Tree Result: 1.849E-03
Number of Cutsets: 684
Number of Basic Events: 93

Fault Tree Name: ic43mb.wlk
Fault Tree Result: 8.957E-02
Number of Cutsets: 21
Number of Basic Events: 23

Fault Tree Name: ic43ml.wlk
Fault Tree Result: 1.849E-03
Number of Cutsets: 684
Number of Basic Events: 93

Fault Tree Name: ic43mp.wlk
Fault Tree Result: 1.861E-03
Number of Cutsets: 1064
Number of Basic Events: 100

Fault Tree Name: ic43mq.wlk
Fault Tree Result: 2.210E-03
Number of Cutsets: 750

Number of Basic Events: 89

Fault Tree Name: ic43mt.wlk
Fault Tree Result: 2.210E-03
Number of Cutsets: 750
Number of Basic Events: 89

Fault Tree Name: ic43mw.wlk
Fault Tree Result: 1.849E-03
Number of Cutsets: 684
Number of Basic Events: 93

Fault Tree Name: ic43mwp.wlk
Fault Tree Result: 8.885E-05
Number of Cutsets: 961
Number of Basic Events: 86

Fault Tree Name: ic44a.wlk
Fault Tree Result: 1.481E-05
Number of Cutsets: 418
Number of Basic Events: 72

Fault Tree Name: ic44ab.wlk
Fault Tree Result: 6.057E-03
Number of Cutsets: 35
Number of Basic Events: 30

Fault Tree Name: ic44al.wlk
Fault Tree Result: 1.486E-05
Number of Cutsets: 421
Number of Basic Events: 72

Fault Tree Name: ic44ap.wlk
Fault Tree Result: 2.574E-05
Number of Cutsets: 773
Number of Basic Events: 86

Fault Tree Name: ic44m.wlk
Fault Tree Result: 1.849E-03
Number of Cutsets: 612
Number of Basic Events: 100

Fault Tree Name: ic44mb.wlk
Fault Tree Result: 8.957E-02
Number of Cutsets: 21
Number of Basic Events: 23

Fault Tree Name: ic44ml.wlk
Fault Tree Result: 1.849E-03
Number of Cutsets: 612
Number of Basic Events: 100

Fault Tree Name: ic44mp.wlk
Fault Tree Result: 1.861E-03
Number of Cutsets: 993
Number of Basic Events: 111

Fault Tree Name: ic44mq.wlk
Fault Tree Result: 2.210E-03
Number of Cutsets: 678
Number of Basic Events: 96

Fault Tree Name: ic44mt.wlk
Fault Tree Result: 2.210E-03
Number of Cutsets: 678
Number of Basic Events: 96

Fault Tree Name: ic44mw.wlk
Fault Tree Result: 1.849E-03
Number of Cutsets: 612
Number of Basic Events: 100

Fault Tree Name: ic44mwp.wlk
Fault Tree Result: 8.873E-05
Number of Cutsets: 890
Number of Basic Events: 89

Fault Tree Name: irw-ic1.wlk
Fault Tree Result: 7.046E-04
Number of Cutsets: 735
Number of Basic Events: 93

Fault Tree Name: irw-ic2.wlk
Fault Tree Result: 7.046E-04
Number of Cutsets: 735
Number of Basic Events: 93

Fault Tree Name: irw-ic3.wlk
Fault Tree Result: 7.046E-04
Number of Cutsets: 706
Number of Basic Events: 92

Fault Tree Name: irw-ic4.wlk
Fault Tree Result: 7.046E-04
Number of Cutsets: 706
Number of Basic Events: 92

Fault Tree Name: irw-ic5.wlk
Fault Tree Result: 1.204E-03
Number of Cutsets: 646
Number of Basic Events: 92

Fault Tree Name: irw-ic6.wlk
Fault Tree Result: 1.204E-03
Number of Cutsets: 646
Number of Basic Events: 92

Fault Tree Name: irw-ic7.wlk
Fault Tree Result: 1.202E-03
Number of Cutsets: 649
Number of Basic Events: 93

Fault Tree Name: irw-ic8.wlk

```
Fault Tree Result:       1.202E-03
Number of Cutsets:       649
Number of Basic Events:  93

Fault Tree Name:         irw-ic9.wlk
Fault Tree Result:       6.084E-03
Number of Cutsets:       58
Number of Basic Events:  32

Fault Tree Name:         irw-ic10.wlk
Fault Tree Result:       6.084E-03
Number of Cutsets:       58
Number of Basic Events:  32

Fault Tree Name:         irw-ic11.wlk
Fault Tree Result:       6.084E-03
Number of Cutsets:       58
Number of Basic Events:  32

Fault Tree Name:         irw-ic12.wlk
Fault Tree Result:       6.084E-03
Number of Cutsets:       58
Number of Basic Events:  32

Fault Tree Name:         irw-ic13.wlk
Fault Tree Result:       3.975E-03
Number of Cutsets:       737
Number of Basic Events:  77
```

***** The following three fault tree results**
***** reflect the results of these trees**
***** before the tree logic change described in**
***** RAI 720.310**

```
Fault Tree Name:         irw-ic14.wlk
Fault Tree Result:       4.571E-09
Number of Cutsets:       5
Number of Basic Events:  4

Fault Tree Name:         irw-ic15.wlk
Fault Tree Result:       4.571E-09
Number of Cutsets:       5
Number of Basic Events:  4

Fault Tree Name:         irw-ic16.wlk
Fault Tree Result:       4.571E-09
Number of Cutsets:       5
Number of Basic Events:  4

***

Fault Tree Name:         mfw-ic1.wlk
Fault Tree Result:       5.413E-03
Number of Cutsets:       395
Number of Basic Events:  63
```

```
Fault Tree Name:          mfw-ic2.wlk
Fault Tree Result:        5.413E-03
Number of Cutsets:        395
Number of Basic Events:   63

Fault Tree Name:          mss-ic1.wlk
Fault Tree Result:        2.461E-03
Number of Cutsets:        912
Number of Basic Events:   106

Fault Tree Name:          mss-ic2.wlk
Fault Tree Result:        7.399E-04
Number of Cutsets:        865
Number of Basic Events:   84

Fault Tree Name:          pcs-ic1.wlk
Fault Tree Result:        5.929E-07
Number of Cutsets:        254
Number of Basic Events:   46

Fault Tree Name:          pcs-ic2.wlk
Fault Tree Result:        5.193E-07
Number of Cutsets:        194
Number of Basic Events:   44

Fault Tree Name:          pls-rods.wlk
Fault Tree Result:        7.326E-04
Number of Cutsets:        262
Number of Basic Events:   51

Fault Tree Name:          rhr-ic01.wlk
Fault Tree Result:        9.283E-07
Number of Cutsets:        299
Number of Basic Events:   57

Fault Tree Name:          rhr-ic02.wlk
Fault Tree Result:        8.547E-07
Number of Cutsets:        239
Number of Basic Events:   56

Fault Tree Name:          rhr-ic03.wlk
Fault Tree Result:        1.350E-06
Number of Cutsets:        200
Number of Basic Events:   46

Fault Tree Name:          rhr-ic04.wlk
Fault Tree Result:        1.276E-06
Number of Cutsets:        140
Number of Basic Events:   43

Fault Tree Name:          rhr-ic05.wlk
Fault Tree Result:        9.625E-07
Number of Cutsets:        476
Number of Basic Events:   63

Fault Tree Name:          rhr-ic06.wlk
```

```
Fault Tree Result:        8.921E-07
Number of Cutsets:        428
Number of Basic Events:   64

Fault Tree Name:          rhr-ic09.wlk
Fault Tree Result:        5.053E-04
Number of Cutsets:        729
Number of Basic Events:   90

Fault Tree Name:          rhr-ic10.wlk
Fault Tree Result:        5.052E-04
Number of Cutsets:        700
Number of Basic Events:   89

Fault Tree Name:          rhr-ic11.wlk
Fault Tree Result:        5.821E-04
Number of Cutsets:        737
Number of Basic Events:   77

Fault Tree Name:          rhr-ic12.wlk
Fault Tree Result:        5.821E-04
Number of Cutsets:        706
Number of Basic Events:   76

Fault Tree Name:          rhr-ic13.wlk
Fault Tree Result:        5.821E-04
Number of Cutsets:        737
Number of Basic Events:   77

Fault Tree Name:          rhr-ic14.wlk
Fault Tree Result:        5.821E-04
Number of Cutsets:        706
Number of Basic Events:   76

Fault Tree Name:          rhr-ic1a.wlk
Fault Tree Result:        1.825E-05
Number of Cutsets:        518
Number of Basic Events:   88
```

***** The following fault tree result**
***** reflects the results of these trees**
***** before the tree logic change described in**
***** RAI 720.313**

```
Fault Tree Name:          rhr-ic2a.wlk
Fault Tree Result:        1.751E-03
Number of Cutsets:        1204
Number of Basic Events:   128
```

*******

```
Fault Tree Name:          rns-ic1.wlk
Fault Tree Result:        5.767E-04
Number of Cutsets:        705
Number of Basic Events:   75
```

```
Fault Tree Name:          rns-ic1p.wlk
Fault Tree Result:        1.136E-03
Number of Cutsets:        556
Number of Basic Events: 76

Fault Tree Name:          rns-ic2.wlk
Fault Tree Result:        5.768E-04
Number of Cutsets:        736
Number of Basic Events: 76

Fault Tree Name:          rns-ic2p.wlk
Fault Tree Result:        1.138E-03
Number of Cutsets:        549
Number of Basic Events: 75

Fault Tree Name:          rns-ic3.wlk
Fault Tree Result:        5.768E-04
Number of Cutsets:        736
Number of Basic Events: 76

Fault Tree Name:          rns-ic3p.wlk
Fault Tree Result:        1.138E-03
Number of Cutsets:        549
Number of Basic Events: 75

Fault Tree Name:          rns-ic4.wlk
Fault Tree Result:        5.767E-04
Number of Cutsets:        705
Number of Basic Events: 75

Fault Tree Name:          rns-ic4p.wlk
Fault Tree Result:        1.136E-03
Number of Cutsets:        556
Number of Basic Events: 76

Fault Tree Name:          rns-ic5.wlk
Fault Tree Result:        1.000E-06
Number of Cutsets:        2
Number of Basic Events: 2

Fault Tree Name:          rpt-ic01.wlk
Fault Tree Result:        6.229E-04
Number of Cutsets:        801
Number of Basic Events: 94

Fault Tree Name:          rpt-ic02.wlk
Fault Tree Result:        6.229E-04
Number of Cutsets:        772
Number of Basic Events: 93

Fault Tree Name:          rpt-ic03.wlk
Fault Tree Result:        6.229E-04
Number of Cutsets:        801
Number of Basic Events: 94

Fault Tree Name:          rpt-ic04.wlk
```

```
Fault Tree Result:       6.229E-04
Number of Cutsets:       772
Number of Basic Events: 93

Fault Tree Name:         rpt-ic05.wlk
Fault Tree Result:       6.229E-04
Number of Cutsets:       801
Number of Basic Events: 94

Fault Tree Name:         rpt-ic06.wlk
Fault Tree Result:       6.229E-04
Number of Cutsets:       772
Number of Basic Events: 93

Fault Tree Name:         rpt-ic07.wlk
Fault Tree Result:       6.229E-04
Number of Cutsets:       801
Number of Basic Events: 94

Fault Tree Name:         rpt-ic08.wlk
Fault Tree Result:       6.229E-04
Number of Cutsets:       772
Number of Basic Events: 93

Fault Tree Name:         rpt-ic09.wlk
Fault Tree Result:       1.174E-04
Number of Cutsets:       205
Number of Basic Events: 49

Fault Tree Name:         rpt-ic10.wlk
Fault Tree Result:       1.173E-04
Number of Cutsets:       144
Number of Basic Events: 45

Fault Tree Name:         rpt-ic11.wlk
Fault Tree Result:       1.174E-04
Number of Cutsets:       205
Number of Basic Events: 49

Fault Tree Name:         rpt-ic12.wlk
Fault Tree Result:       1.173E-04
Number of Cutsets:       144
Number of Basic Events: 45

Fault Tree Name:         rpt-ic13.wlk
Fault Tree Result:       1.174E-04
Number of Cutsets:       205
Number of Basic Events: 49

Fault Tree Name:         rpt-ic14.wlk
Fault Tree Result:       1.173E-04
Number of Cutsets:       144
Number of Basic Events: 45

Fault Tree Name:         rpt-ic15.wlk
Fault Tree Result:       1.174E-04
```

```
Number of Cutsets:        205
Number of Basic Events: 49

Fault Tree Name:          rpt-ic16.wlk
Fault Tree Result:        1.173E-04
Number of Cutsets:        144
Number of Basic Events: 45

Fault Tree Name:          rpt-ic17.wlk
Fault Tree Result:        1.174E-04
Number of Cutsets:        209
Number of Basic Events: 49

Fault Tree Name:          rpt-ic18.wlk
Fault Tree Result:        1.173E-04
Number of Cutsets:        147
Number of Basic Events: 45

Fault Tree Name:          rpt-ic19.wlk
Fault Tree Result:        1.174E-04
Number of Cutsets:        209
Number of Basic Events: 49

Fault Tree Name:          rpt-ic20.wlk
Fault Tree Result:        1.173E-04
Number of Cutsets:        147
Number of Basic Events: 45

Fault Tree Name:          rpt-ic21.wlk
Fault Tree Result:        1.174E-04
Number of Cutsets:        209
Number of Basic Events: 49

Fault Tree Name:          rpt-ic22.wlk
Fault Tree Result:        1.173E-04
Number of Cutsets:        147
Number of Basic Events: 45

Fault Tree Name:          rpt-ic23.wlk
Fault Tree Result:        1.174E-04
Number of Cutsets:        209
Number of Basic Events: 49

Fault Tree Name:          rpt-ic24.wlk
Fault Tree Result:        1.173E-04
Number of Cutsets:        147
Number of Basic Events: 45

Fault Tree Name:          sfw-ic1.wlk
Fault Tree Result:        1.418E-03
Number of Cutsets:        653
Number of Basic Events: 93

Fault Tree Name:          sfw-ic1a.wlk
Fault Tree Result:        1.977E-03
Number of Cutsets:        758
```

```
Number of Basic Events: 103

Fault Tree Name:        sfw-ic1p.wlk
Fault Tree Result:      4.887E-03
Number of Cutsets:      579
Number of Basic Events: 90

Fault Tree Name:        sfw-ic2.wlk
Fault Tree Result:      1.418E-03
Number of Cutsets:      653
Number of Basic Events: 93

Fault Tree Name:        sfw-ic2a.wlk
Fault Tree Result:      1.977E-03
Number of Cutsets:      758
Number of Basic Events: 103

Fault Tree Name:        sfw-ic2p.wlk
Fault Tree Result:      4.887E-03
Number of Cutsets:      579
Number of Basic Events: 90

Fault Tree Name:        sfw-ic3.wlk
Fault Tree Result:      7.014E-04
Number of Cutsets:      653
Number of Basic Events: 77

Fault Tree Name:        sfw-ic4.wlk
Fault Tree Result:      8.998E-04
Number of Cutsets:      494
Number of Basic Events: 88

Fault Tree Name:        sfw-ic4p.wlk
Fault Tree Result:      4.363E-03
Number of Cutsets:      443
Number of Basic Events: 94

Fault Tree Name:        sfw-ic5.wlk
Fault Tree Result:      8.998E-04
Number of Cutsets:      494
Number of Basic Events: 88

Fault Tree Name:        sfw-ic5p.wlk
Fault Tree Result:      4.363E-03
Number of Cutsets:      443
Number of Basic Events: 94

Fault Tree Name:        sfw-ic6.wlk
Fault Tree Result:      8.998E-04
Number of Cutsets:      494
Number of Basic Events: 88

Fault Tree Name:        sfw-ic6p.wlk
Fault Tree Result:      4.363E-03
Number of Cutsets:      443
Number of Basic Events: 94
```

Fault Tree Name: sfw-ic7.wlk
Fault Tree Result: 8.998E-04
Number of Cutsets: 494
Number of Basic Events: 88

Fault Tree Name: sfw-ic7p.wlk
Fault Tree Result: 4.363E-03
Number of Cutsets: 443
Number of Basic Events: 94

Fault Tree Name: sfw-ic8.wlk
Fault Tree Result: 7.014E-04
Number of Cutsets: 653
Number of Basic Events: 77

Fault Tree Name: sfw-ic8p.wlk
Fault Tree Result: 4.266E-03
Number of Cutsets: 418
Number of Basic Events: 73

Fault Tree Name: sgs-ic1.wlk
Fault Tree Result: 2.119E-04
Number of Cutsets: 327
Number of Basic Events: 70

Fault Tree Name: sgs-ic2.wlk
Fault Tree Result: 2.119E-04
Number of Cutsets: 327
Number of Basic Events: 70

Fault Tree Name: sgs-ic3.wlk
Fault Tree Result: 2.121E-04
Number of Cutsets: 284
Number of Basic Events: 61

Fault Tree Name: sgs-ic4.wlk
Fault Tree Result: 1.213E-05
Number of Cutsets: 284
Number of Basic Events: 61

Fault Tree Name: sgs-ic5.wlk
Fault Tree Result: 1.281E-04
Number of Cutsets: 284
Number of Basic Events: 61

Fault Tree Name: sgs-ic6.wlk
Fault Tree Result: 1.213E-05
Number of Cutsets: 284
Number of Basic Events: 61

Fault Tree Name: sgs-ic7.wlk
Fault Tree Result: 2.121E-04
Number of Cutsets: 284
Number of Basic Events: 61

Fault Tree Name: sgs-ic8.wlk

```
Fault Tree Result:       2.121E-04
Number of Cutsets:       284
Number of Basic Events:  61

Fault Tree Name:         sws-ic1.wlk
Fault Tree Result:       1.071E-02
Number of Cutsets:       533
Number of Basic Events:  87

Fault Tree Name:         sws-ic2.wlk
Fault Tree Result:       5.214E-04
Number of Cutsets:       823
Number of Basic Events:  93

Fault Tree Name:         sws-ic3.wlk
Fault Tree Result:       1.340E-03
Number of Cutsets:       708
Number of Basic Events:  87

Fault Tree Name:         sws-ic4.wlk
Fault Tree Result:       5.286E-04
Number of Cutsets:       836
Number of Basic Events:  94

Fault Tree Name:         sws-ic5.wlk
Fault Tree Result:       1.348E-03
Number of Cutsets:       765
Number of Basic Events:  87

Fault Tree Name:         sws-ic6.wlk
Fault Tree Result:       1.348E-03
Number of Cutsets:       765
Number of Basic Events:  87

Fault Tree Name:         sws-ic7.wlk
Fault Tree Result:       1.340E-03
Number of Cutsets:       708
Number of Basic Events:  87

Fault Tree Name:         tcs-ic1.wlk
Fault Tree Result:       5.190E-04
Number of Cutsets:       810
Number of Basic Events:  93

Fault Tree Name:         vls-ic1.wlk
Fault Tree Result:       9.608E-05
Number of Cutsets:       640
Number of Basic Events:  76

Fault Tree Name:         vws-ic1.wlk
Fault Tree Result:       5.796E-03
Number of Cutsets:       697
Number of Basic Events:  79
```

Re: PRA I&C modeling question from NRC letter dated January 22, 1996

Question 720.310 (#3041)

Subtrees IRW-IC13, IRW-IC14, IRW-IC15, and IRW-IC16 all appear to have similar logic. However, IRW-IC13 has some 737 cut sets (according to file IRW-IC13.WLK) while only 4 cut sets are reported for IRW-IC14, IRW-IC15, and IRW-IC16 (according to their .WLK files). Note that the probability of subtree IRW-IC13 is reported to be about 0.004; the probability of subtrees IRW-IC14 through IRW-IC16 is reported to be about 5E-9. Is some of the logic in subtrees IRW-IC14, IRW-IC15, and IRW-IC16 to be neglected in the analysis? If so, please provide a justification for this treatment.

Response:

A logic correction was made to the IRW-IC14, IRW-IC15, and IRW-IC16 fault trees for the June 1995 submittal of the PRA. The top level gates for these trees, formerly an AND gate, was corrected to an OR gate.

Re: PRA I&C modeling question from NRC letter dated January 22, 1996

Question 720.311 (#3042)

According to Table 26-2e (trees CVS-IC4 and CVS-IC5, pages 26-79, 80) it appears that subtree MPLL03 should transfer into subtree MESOUTA. The staff was unable to find this transfer in the WCAP-13275 fault trees. Does fault tree MPLL03 affect CVS-IC4 and CVS-IC5? If so, please indicate where MPLL03 should transfer into MESOUTA.

Response:

The associated fault tree models are correct and do not incorporate MPLL03. The "MPLL03" in Table 26-2e for CVS-IC4 and CVS-IC5 will be deleted.

Re: PRA I&C modeling question from NRC letter dated January 22, 1996

Question 720.312 (#3043)

Table 26-11, page 26-215, SG 1 and 2, FW NR (Narrow Range) FLOW. In general, the SG1 and SG2 sensors support SG1 and SG2, respectively. In the case of the feedwater narrow range flow sensors, it appears that the "SG2" sensors support SG1 and the "SG1" sensors support SG2. Is this characterization correct? Please explain.

Response:

The names of the sensors are incorrectly labeled, however the names are used consistently such that the resultant logic of the models is correct. No incorrect cutset combinations occur due to the naming.

Re: PRA I&C modeling question from NRC letter dated January 22, 1996

Question 720.313 (#3044)

RHR-IC2A, Figure 26-62, page 531. Event TRANS-E2 is found in the RHR-IC2A.WLK file, but there appear to be no transfer labels or logic structures for TRANS-E2 in the WCAP-13275 fault trees. What does this event represent? What files/logic are associated with it?

Response:

The "transfer out" gate that fed a "transfer in" gate was mistakenly deleted. This basic event should be replaced with subtree SUB-ED32HR, the non-class 1E dc power supply to the DAS. This error was corrected before the June 1995 submittal of the PRA.

Re: PRA I&C modeling question from NRC letter dated January 22, 1996

Question 720.319 (#3050)

Table 26-2e (page 26-42). The sub-trees involved with tree IC22AP are AESOUTBP and MESOUTBP. Also, file IC22AP.WLK includes basic events ADBEP002BSA and ADBEP012BSA. Again, this seems to contradict the naming convention. Is the apparent mismatch intentional? If so, should the IC22AP event description use V002B and V012B instead of V002A and V012A? Please explain.

Response:

Table 26-2e incorrectly references valves V002A and V012A as described in the RAI. Fault tree IC22AP models failure to actuate line 2 of ADS stage 2 during a loss of offsite power. The PMS division modeled to perform this function is division B. The sub-trees AESOUTBP and MESOUTBP are correct, as are the output driver modules' basic event names ADBEP002BSA and ADBEP012BSA. The correct valves will be referenced in the table in revision 7 of the PRA.