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Accident Management Information Needs

Appendices A – F

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APPENDIX A

**INFORMATION-NEEDS TABLES FOR A
PWR WITH A LARGE, DRY CONTAINMENT**

APPENDIX A

INFORMATION-NEEDS TABLES FOR A PWR WITH A LARGE, DRY CONTAINMENT

The tables contained in this Appendix A describe the information needs for a pressurized water reactor (PWR) with a large, dry containment. To identify these information needs, the branch points in the safety objective trees were examined to decide what information is necessary to (a) determine the status of the safety functions in the plant, i.e., whether the safety functions are being adequately maintained within predetermined limits, (b) identify plant behavior (mechanisms) or precursors to this behavior which indicate that a challenge to plant safety is occurring or is imminent, and (c) select strategies that will prevent or mitigate this plant behavior and monitor the implementation and effectiveness of these strategies. The information needs for the challenges to the safety functions are not examined since the summation of the information needs for all mechanisms associated with a challenge comprise the information needs for the challenge itself.

In the tables, the rows correspond to five levels of information which were derived from the levels of the safety objective trees. The first section (row) of the table contains the information needs that relate to the safety function. This section is used to describe the information needed to determine whether the safety function is being maintained within the accepted safety limits. The second section (row) of the table displays information to identify a specific mechanism that may be a challenge to a safety function. Two different categories of information are important for identifying mechanisms: indicators and precursors. The indicators include information that identifies when a mechanism is actually occurring and challenging a safety function. The precursor information identifies whether a mechanism would be expected to occur in the future based on currently available information.

The final three categories (rows) relate to strategy selection and evaluation. The Selection Criteria category identifies the information needed to determine

which strategies should be selected for a given situation, including consideration of the plant conditions under which the strategy can operate and be effective. The Strategy Initiation category gives the information needed for the operating staff to determine whether a strategy has been implemented as intended. The Strategy Effectiveness row describes the information needed to determine whether the strategy is having its intended effect; that is, whether implementation of the strategy is having a beneficial effect on the status of the safety function that is being challenged.

The respective columns in the table format include the identified information needs, the sources of the information categorized as to how well they represent the information needs, and the existing measurements that could supply the needed information. The information sources are subdivided into those that are considered to be either direct or indirect. A direct information source is one that can be used to provide information that will positively determine the presence or absence of a specific condition on the safety objective tree. For example, if the safety function addresses pressure control, a pressure measurement is a direct information source for understanding challenges to the safety function. An indirect information source can be used to infer the needed information, but there may be conditions in which the information source may provide ambiguous results. For example, core exit temperature readings may provide reasonable information for fuel cladding temperatures for some system conditions, but would not provide an accurate indication for other combinations of system flow and fluid conditions.

Development of the input to the rows and columns required the expertise of personnel with diverse backgrounds. A team of personnel with operations, instrumentation, and severe accident experience were used to produce the tables.

TABLE A1.1. PREVENT CORE DISPERSAL FROM VESSEL (V)--INADEQUATE INVENTORY MECHANISM (V1A1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain RCS Heat Removal Safety Function (V1)	Energy removal rate	None		None	
			RCS fluid temperature	Hot or cold leg RTDs, CETs	
			RCS pressure	Pressurizer pressure	
			Steam generator steam flow	Steam flow indicators	
			PORV discharge pipe noise	Acoustic monitor	
			RHR heat removal	RHR flows, temperatures	
	<u>Indicator</u>				
Inadequate Secondary Inventory Mechanism (V1A1)	Secondary fluid inventory	Secondary liquid level		Secondary liquid level	

TABLE A1.1. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Precursor</u>				
	Feedwater flow status	Feedwater flow rate		Feedwater flow rate (MFW flow AFW flow)	
	<u>Selection Criteria</u>				
Injection Methods Strategy	Inventory availability	Tank inventories		Tank levels	
	Pumping capability	Electrical power availability			
		Steam availability			
	Alignment capability	Valve alignments		Valve position indicators	
	<u>Strategy Initiation</u>				
	Feedwater flow status	Feedwater flow rate		Feedwater flow rate (MFW flow AFW flow)	

TABLE A1.1. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Initiation (continued)</u>				
	Injection water inventory (decreasing)	Tank inventory		Tank level SI Tanks RWST	
	<u>Strategy Effectiveness</u>				
	RCS fluid temperature	RCS fluid temperature		Hot or cold leg RTDs, CETs	
	Secondary fluid inventory	Secondary liquid level		Secondary liquid level	
	<u>Selection Criteria</u>				
Inventory Sources Strategy	Inventory availability	Tank inventories		Tank level (SIT RWST)	
	Pumping capability	Electric power availability Steam availability			

TABLE A1.1. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Selection Criteria (continued)</u>				
Alignment capability	Valve alignments		Valve position indicators	
<u>Strategy Initiation</u>				
Injection water inventory (decreasing)	Tank inventory		Tank level (SIT RWST)	
Feedwater flow status	Feedwater flow rate		Feedwater flow rate (MFW flow AFW flow)	
<u>Strategy Effectiveness</u>				
RCS fluid temperature	RCS fluid temperature		Hot or cold leg RTDs, CETs	
Secondary fluid inventory	Secondary liquid level		Secondary liquid level	

TABLE A1.2. PREVENT CORE DISPERSAL FROM VESSEL (V)--INADEQUATE PRESSURE CONTROL MECHANISM (V1A2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain RCS Heat Removal Safety Function (V1)	Energy removal rate	None		None	
			RCS fluid temperature	Hot or cold leg RTDs, CETs	
			RCS pressure	Pressurizer pressure	
			Steam generator steam flow	Steam flow indicators	
			PORV directory pipe noise	Acoustic monitors	
			RHR heat removal	RHR flows, temperatures	
	<u>Indicator</u>				
Inadequate Pressure Control Mechanism (V1A2)	RCS - Steam Generator Pressure difference	Steam generator secondary pressure		Steam generator secondary pressure	
		RCS pressure		Pressurizer pressure	

TABLE A1.2. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Precursor</u>				
	Secondary ADV flow rate	ADV flow indicator	ADV valve position	None	
	Steam dump flow rate	None	Steam dump valve position	Steam dump valve position indicator	
	Turbine bypass flow rate	Turbine bypass flow indicator		Turbine bypass flow indicator	
	<u>Selection Criteria</u>				
Open Secondary ADV Strategy	RCS - Steam generator pressure difference	Steam generator secondary pressure		Steam generator secondary pressure	
		RCS pressure		Pressurizer pressure	
	ADV status	Electric power/air availability			

TABLE A1.2. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Initiation</u>				
	Secondary ADV flow rate	ADV flow indicator	ADV valve position	ADV valve position indicator	
	<u>Strategy Effectiveness</u>				
	RCS fluid temperature	RCS fluid temperature		Hot or cold leg RTDs, CETs	
	<u>Selection Criteria</u>				
Open Atmospheric Dump Valves Strategy	RCS - Steam generator pressure difference	Steam generator secondary pressure		Steam generator secondary pressure	
		RCS pressure		Pressurizer pressure	
	Atmospheric dump valve status	Electric power/air availability			
	<u>Strategy Initiation</u>				
	Atmospheric dump valve flow rate	Atmospheric dump valve flow indicator	None	Atmospheric dump valve position	

TABLE A1.2. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Effectiveness</u>				
	RCS fluid temperature	RCS fluid temperature		Hot or Cold leg RTDs, CETs	
	<u>Selection Criteria</u>				
Open Turbine Bypass Valves Strategy	RCS - Steam generator pressure difference	Steam generator secondary pressure		Steam generator secondary pressure	
		RCS pressure		Pressurizer pressure	
	Turbine bypass valve status	Electric power/air availability			
	<u>Strategy Initiation</u>				
	Turbine bypass valve flow rate	Turbine bypass valve flow indicator		Turbine bypass valve flow indicator	
	<u>Strategy Effectiveness</u>				
	RCS fluid temperature	RCS fluid temperature		Hot or cold leg RTDs, CETs	

TABLE A1.3. PREVENT CORE DISPERSAL FROM VESSEL (V)--INADEQUATE RCS ENERGY TRANSPORT MECHANISM (V1A3)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain RCS Heat Safety Function (V1)	Energy removal rate	None		None	
			RCS fluid temperature	Hot or cold leg RTDs, CETs	
			RCS pressure	Pressurizer pressure	
			Steam generator steam flow	Steam flow indicators	
			PORV flow	PORV flow indicators	
			RHR heat removal	RHR flows, temperatures	
	<u>Indicator</u>				
Inadequate RCS Energy Transport Mechanism (V1A3)	RCS energy Transport	None		None	
			RCS flow rate	RCS flow rate	
			RCS fluid temperature	Hot or cold leg RTDs, CETs	
			RCS pressure	Pressurizer pressure	

TABLE A1.3. (continued)

	<u>Information Needs</u>	<u>Direct</u>	<u>Indirect</u>	<u>Available</u>	<u>Potential</u>
		<u>Information</u>	<u>Information</u>	<u>Instruments</u>	<u>Instruments</u>
		<u>Source</u>	<u>Source</u>		
	<u>Precursor</u>				
	RCS Inventory (low)	Vessel inventory	Vessel inventory	RVLMS	
			Pressurizer inventory	Pressurizer level	
			Reactor vessel inventory	RVLMS	
	<u>Selection Criteria</u>				
RCS Pump Restart Strategy	RCS flow rate	RCS flow rate		RCS flow rate	
	RCS pump status	RCS pump speed		RCS pump speed	
	RCS pressure	RCS pressure		Pressurizer pressure	
	Steam generator secondary status	Steam generator secondary pressure		Steam generator secondary pressure	
		Steam generator secondary inventory		Steam generator level	

TABLE A1.3. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Initiation</u>				
	RCS pump speed	RCS pump speed		RCS pump speed	
	RCS flow rate	RCS flow rate		RCS flow rate	
	<u>Strategy Effectiveness</u>				
	RCS fluid temperature	RCS fluid temperature		Hot or cold leg RTDs, CETS	
	RCS pressure	RCS pressure		Pressurizer pressure	
	<u>Selection Criteria</u>				
Injection Methods Strategy	Inventory availability	Tank inventories		Tank levels (SITs, RWST)	
	Pumping capability	Electrical power availability Steam availability			

TABLE A1.3. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Selection Criteria (continued)</u>				
Alignment capability	Valve alignments		Valve position indicators	
<u>Strategy Initiation</u>				
Feedwater flow status	Feedwater flow rate		Feedwater flow rate (MFW flow AFW flow)	
Injection water inventory (decreasing)	Tank inventory		Tank level SI Tanks RWST	
<u>Strategy Effectiveness</u>				
RCS fluid temperature	RCS fluid temperature		Hot or cold leg RTDs, CETs	
Secondary fluid inventory	Secondary liquid level		Secondary liquid level	

TABLE A1.3. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Selection Criteria</u>				
Inventory Sources Strategy	Inventory availability	Tank inventories		Tank level (SIT, RWST)	
	Pumping capability	Electric power availability			
	Alignment capability	Valve alignments		Valve position indicators	
	<u>Strategy Initiation</u>				
	Injection water inventory (decreasing)	Tank inventory		Tank level (SIT, RWST)	
	Feedwater flow status	Feedwater flow rate		Feedwater flow rate (MFW flow AFW flow)	

TABLE A1.3. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Effectiveness</u>				
RCS fluid temperature	RCS fluid temperature		Hot or cold leg RTDs, CETs	
Secondary fluid inventory	Secondary liquid level		Secondary liquid level	

TABLE A1.4. PREVENT CORE DISPERSAL FROM VESSEL (V)--RESTRICTED RCS BLEED MECHANISM (V1B1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain RCS Heat Removal Safety Function (V1)	Energy removal rate	None		None	
			RCS fluid temperature	Hot or cold leg RTDs, CETs	
			RCS pressure	Pressurizer pressure	
			Steam generator steam flow	Steam flow indicators	
			PORV discharge pipe noise	Acoustic monitors	
			RHR heat removal	RHR flows, temperatures	
	<u>Indicator</u>				
Restricted RCS Bleed Mechanism (V1B1)	RCS PORV flow rate	None		None	
			RCS pressure	Pressurizer pressure	
			PORV discharge pipe temperature	PORV discharge pipe temperature	

TABLE A1.4. (continued)

	<u>Information Needs</u>	Direct	Indirect	Available	Potential
		Information Source	Information Source	Instruments	Instruments
Power to PORV Strategy	<u>Indicator (continued)</u>				
			PORV discharge pipe noise	Acoustic monitors	
			Quench tank inventory	Quench tank level	
	<u>Precursor</u>				
	None	None		None	
	<u>Selection Criteria</u>				
	RCS pressure (high)	RCS pressure		Pressurizer pressure	
	RCS inventory (decreasing)	None		None	
			Pressurizer inventory	Pressurizer level	
			Reactor vessel inventory	RVLMS	

TABLE A1.4. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Initiation</u>				
PORV flow (confirmation)	None		None	PORV flow sensor
		RCS pressure	Pressurizer pressure	
		PORV discharge pipe temperature	PORV discharge pipe temperature	
		PORV discharge pipe noise	Acoustic monitors	
		Quench tank inventory	Quench tank level	
<u>Strategy Effectiveness</u>				
RCS pressure history	RCS pressure		Pressurizer pressure	
RCS temperature history	RCS coolant temperature		Subcooled margin monitor	
			Cold and hot leg RTDs, CETs	

TABLE A1.4. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Selection Criteria</u>				
Alternate Systems Strategy	RCS pressure (high)	RCS pressure		Pressurizer pressure	
	RCS inventory (decreasing)	None		None	
			Pressurizer inventory	Pressurizer level	
			Reactor vessel inventory	RVLMS	
	<u>Strategy Initiation</u>				
	Hardware dependent			Hardware dependent	
	<u>Strategy Effectiveness</u>				
	RCS pressure history	RCS pressure		Pressurizer pressure	
	RCS temperature history	RCS coolant temperature		Subcooled margin monitor	
				Cold and hot leg RTDs, CETs	

TABLE A1.5. PREVENT CORE DISPERSAL FROM VESSEL (V)--RHR SYSTEMS INOPERABLE (V1B2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain RCS Heat Removal Safety Function (V1)	Energy removal rate	None		None	
			RCS fluid temperature	Hot or cold leg RTDs, CETs	
			RCS pressure	Pressurizer pressure	
			Steam generator steam flow	Steam flow indicators	
			PORV discharge pipe noise	Acoustic monitors	
			RHR heat removal	RHR flows, temperatures	
	<u>Indicator</u>				
RHR Systems Inoperable Mechanism (V1B2)	RHR energy removal rate	Heat exchanger differential temperature		Heat exchanger inlet and outlet fluid temperatures	
		RHR system flow rate		RHR system flow rate	

TABLE A1.5. (continued)

	<u>Information Needs</u>	Direct	Indirect	Available	Potential
		Information	Information	Instruments	Instruments
		Source	Source		
	<u>Precursor</u>				
	RCS temperature	RCS temperature		Hot and cold leg RTDs, Cets	
	RCS pressure	RCS pressure		Pressurizer pressure	
	<u>Selection Criteria</u>				
RHR Flow Restoration Strategy	RHR system flow rate	RHR system flow rate		RHR system flow rate	
	RCS pressure	RCS pressure		Pressurizer pressure	
	RCS temperature	RCS temperature		Hot or cold leg RTDs, CETs	
	<u>Strategy Initiation</u>				
	RHR system flow rate	RHR system flow rate		RHR system flow rate	
	<u>Strategy Effectiveness</u>				
	RCS temperature	RCS temperature		Hot or cold leg RTDs, CETs	

TABLE A1.5. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Initiation (continued)</u>				
	RCS pressure	RCS pressure		Pressurizer pressure	
	<u>Selection Criteria</u>				
Alternate Heat Sinks Strategy	RHR system flow rate	RHR system flow rate		RHR system flow rate	
	RHR heat exchanger flow rate	RHR heat exchanger flow rate		RHR heat exchanger flow rate	
	RCS pressure	RCS pressure		Pressurizer pressure	
	RCS temperature	RCS temperature		Hot or cold leg RTDs, CETs	
	<u>Strategy Initiation</u>				
	RHR heat exchanger flow rate	RHR heat exchanger flow rate		RHR heat exchanger flow rate	
	RHR system flow rate	RHR system flow rate		RHR system flow rate	

TABLE A1.5. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Effectiveness</u>				
RCS temperature	RCS temperature		Hot or cold leg RTDs, CETs	
RCS pressure	RCS pressure		Pressurizer pressure	

TABLE A1.6. PREVENT CORE DISPERSAL FROM VESSEL (V)--SCRAM FAILURE MECHANISM (V2A1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain Core Heat Removal Safety Function	Core heat removal rate	None		None	
			Fuel rod temperature	None	
			Core exit temperature history	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
			RCS coolant activity level	RCS sampling system	
	<u>Indicator</u>				
Scram Failure Mechanism	Energy generation rate	Neutron detection		Power, intermediate, source range monitors	
	Control Rod positions	Rod position indicator		Rod position indicator	
		Rod bottom indicator		Rod bottom indicator	

TABLE A1.6. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Indicator (continued)</u>				
	Borated water injection rate	Injection flow rates		Self powered neutron detectors	
			Borated water storage tank inventory	HPIS, LPIS charging system flow rates	
				Tank levels	
	<u>Precursor</u>				
	None				
	<u>Selection Criteria</u>				
Control Rod Insertion Strategies	Control Rod position	Rod position indicator		Rod position indicator	
	Energy generation rate	Neutron detection		Power, intermediate, source range monitors	

TABLE A1.6. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Initiation</u>				
	Control rod position indicator	Control rod position indicator		Control rod position indicator	
		Rod bottom indicator		Rod bottom indicator	
	<u>Strategy Effectiveness</u>				
	Energy generation rate	Neutron detection		Power, intermediate, source range monitors	
	<u>Selection Criteria</u>				
Injection Methods Strategies	Alignment capabilities	Valve alignments		Valve position indicators	
	Pumping capabilities	Electrical power availability			
	Borated water inventory availability	Tank inventories		Tank levels	

TABLE A1.6. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Initiation</u>				
	RCS injection status	RCS injection flow rate		RCS injection discharge flow rate and pressure	
	Injection water inventory (decreasing)	Tank inventory		Tank level (RWST SIT)	
	<u>Strategy Effectiveness</u>				
	Energy generator rate	Neutron detection		Power, intermediate, source range monitors	
				Self-powered neutron detectors	
	<u>Selection Criteria</u>				
Boration Methods Strategies	Energy generation rate	Neutron detection		Power, intermediate, source range monitors	
	Borated water availability	Tank inventories		Tank levels	

TABLE A1.6. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Selection Criteria (continued)</u>				
Injection system capabilities	Injection system status			
<u>Strategy Initiation</u>				
RCS injection status	RCS injection flow rate		RCS injection discharge flow rate and pressure	
<u>Strategy Effectiveness</u>				
Energy generator rate	Neutron detection		Power, intermediate, source range monitors	
			Self-powered neutron detectors	

TABLE A1.7. PREVENT CORE DISPERSAL FROM VESSEL (V)--RECRITICALITY (V2A2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain Core Heat Removal Safety Function	Core heat removal	None		None	
			Fuel rod temperature	None	
			Core exit temperature history	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
			RCS coolant activity level	RCS sampling system	
	<u>Indicator</u>				
Recriticality Mechanism (V2A2)	Energy generation rate	Neutron detector		Power, intermediate, source range monitors	
				Self-powered neutron detectors	

TABLE A1.7. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Precursor</u>				
	RCS fluid temperature (low)	RCS fluid temperature		Hot or cold leg RTDs, CETs	
	Location of control rod material	None		None	
			Core exit temperature	Core exit thermocouple	
	<u>Selection Criteria</u>				
Injection Methods Strategies	Alignment capabilities	Valve alignments		Valve position indicators	
	Pumping capabilities	Electrical power availability			
	Borated water inventory availability	Tank inventories		Tank levels	

TABLE A1.7. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Initiation</u>				
	RCS injection status	RCS injection flow rate		RCS injection discharge flow rate and pressure	
	Injection water inventory (decreasing)	Tank inventory		Tank level (RWST SIT)	
	<u>Strategy Effectiveness</u>				
	Energy generator rate	Neutron detection		Power, intermediate, source range monitors	
				Self-powered neutron detectors	
	<u>Selection Criteria</u>				
Boration Methods Strategies	Energy generation rate	Neutron detection		Power, intermediate, source range monitors	
	Borated water availability	Tank inventories		Tank levels	

TABLE A1.7. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Selection Criteria (continued)</u>				
Injection system capabilities	Injection system status			
<u>Strategy Initiation</u>				
RCS injection status	RCS injection flow rate		RCS injection discharge flow rate and pressure	
<u>Strategy Effectiveness</u>				
Energy generator rate	Neutron detection		Power, intermediate, source range monitors	
			Self-powered neutron detectors	

TABLE A1.8. PREVENT CORE DISPERSAL FROM VESSEL (V)--CIRCULATION FAILURE MECHANISM (V2A3)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain Core Heat Removal Safety Function	Core heat removal	None		None	
			Fuel rod temperature	None	
			Core exit temperature history	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
			RCS coolant activity level	RCS sampling system	
	<u>Indicator</u>				
Circulation Failure Mechanism (V2A3)	RCS flow status	RCS flow rate		RCS flow rate	
		RCS pump speed		RCS pump speed	
		RCS pump differential pressure		RCS pump differential pressure	

TABLE A1.8. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Indicator (continued)</u>				
	Fuel rod cladding temperature (high)	None	Core exit temperature	None Core exit thermocouple	
	<u>Precursor</u>				
	RCS pump status	Bearing temperature		Bearing thermocouple	
		Lube oil pressure		Lube oil pump differential pressure	
		Electrical power			
	<u>Selection Criteria</u>				
RCS Pump Restart Strategy	RCS flow status	RCS flow rate		RCS flow rate	
		RCS pump speed		RCS pump speed	
		RCS pump differential pressure		RCS pump differential pressure	

TABLE A1.8. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Selection Criteria (continued)</u>				
Fuel rod cladding temperature	None		None	
		Core exit temperature	Core exit thermocouple	
<u>Strategy Initiation</u>				
RCS flow status	RCS flow rate		RCS flow rate	
<u>Strategy Effectiveness</u>				
RCS flow status	RCS flow rate		RCS flow rate	
Fuel rod cladding temperature	None		None	
		Core exit temperature	Core exit thermocouple	

TABLE A1.9. PREVENT CORE DISPERSAL FROM VESSEL (V)--INADEQUATE RCS INVENTORY (V2A4)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain Core Heat Removal Safety Function	Core heat removal	None		None	
			Fuel rod temperature	None	
			Core exit temperature history	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
			RCS coolant activity level	RCS sampling system	
	<u>Indicator</u>				
Inadequate RCS Inventory Mechanism (V2A4)	RCS inventory status	None		None	
			Pressurizer inventory	Pressurizer level	
			Reactor vessel inventory	RVLMS	
			Core exit temperature	Core exit thermocouple	

TABLE A1.9. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Indicator (continued)</u>				
	Containment sump inventory (increasing)	Containment sump level		Containment sump level	
	<u>Precursor</u>				
	RCS pressure (low)	RCS pressure		Pressurizer pressure	
	Injection flow rate	Injection flow rate		Injection flow rate	
	<u>Selection Criteria</u>				
RCS Injection Methods	RCS pressure history	RCS pressure		Pressurizer pressure	
Strategies	RCS inventory (trend)	None		None	
			Pressurizer inventory	Pressurizer level	
			Reactor vessel inventory	RVLMS	

TABLE A1.9. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Selection Criteria (continued)</u>				
Injection water availability (partial)	RCS injection water tanks inventories		Tank levels (VCT RWST SIT)	
	Containment sump inventory		Sump levels	
<u>Strategy Initiation</u>				
Injection pump flow HPSI/LPSI/CP	Injection pump flow rate		Flow indication	
			Pump outlet pressure	
			Pump motor current	
Injection water availability (decreasing) (partial)	RCS injection water tanks inventories		Tank level (VCT RWST SIT)	

TABLE A1.9. (continued)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments
<u>Information Needs</u>					
<u>Strategy Effectiveness</u>					
	RCS inventory history	None		None	
			Pressurizer inventory	Pressurizer level	
			Reactor vessel inventory	RVLMS	
<u>Selection Criteria</u>					
RCS Inventory Sources Strategies	Inventory availability	Tank inventories		Tank level	
	Pumping capability	Electric power availability			
		Steam availability			
	Alignment capability	Valve alignments		Valve position indicators	

TABLE A1.9. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Initiation</u>				
Injection water inventory (decreasing)	Tank inventory		Tank level (RWST SIT)	
Feedwater flow status	Feedwater flow rate		Feedwater flow rate	
<u>Strategy Effectiveness</u>				
RCS fluid temperature	RCS fluid temperature		Hot or cold leg RTDs, CETs	
Secondary fluid inventory	Secondary liquid level		Secondary liquid level	

TABLE A1.10. CHANGE IN CORE GEOMETRY MECHANISM (V2B1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain Core Heat Removal Safety Function	Core heat removal	None		None	
			Fuel rod temperature	None	
			Core exit temperature history	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
			RCS coolant activity level	RCS sampling system	
	<u>Indicators</u>				
Change in Core Geometry Mechanism (V2B1)	Core material temperature and geometry	Cladding and fuel location and temperature		None	Cladding temperature thermocouple
			Fuel relocation to lower plenum	Source range monitor	
	<u>Precursors</u>				
	High cladding temperature	Cladding and fuel temperature		None	Cladding temperature thermocouple
			Core exit temperature	Core exit thermocouples	

TABLE A1.10. (continued)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments
<u>Information Needs</u>					
<u>Precursors (continued)</u>					
			Cladding temperature	SPNDs	
			Coolant activity level	RCS sampling system	
<u>Selection Criteria</u>					
A-44	RCS Pump Restart Strategy	RCS flow status	RCS flow rate	RCS flow rate	
			RCS pump speed	RCS pump speed	
			RCS pump differential pressure	RCS pump differential pressure	
		Fuel rod cladding temperature	None	None	
			Core exit temperature	Core exit thermocouple	
<u>Strategy Initiation</u>					
	RCS flow status	RCS flow rate		RCS flow rate	

TABLE A1.10. (continued)

	<u>Information Needs</u>	<u>Direct</u>	<u>Indirect</u>	<u>Available</u>	<u>Potential</u>
		<u>Information</u>	<u>Information</u>	<u>Instruments</u>	<u>Instruments</u>
		<u>Source</u>	<u>Source</u>		
	<u>Strategy Effectiveness</u>				
	RCS flow status	RCS flow rate		RCS flow rate	
	Fuel rod cladding temperature	None	Core exit temperature	None Core exit thermocouple	
	<u>Selection Criteria</u>				
RCS Injection Methods Strategies	RCS pressure history	RCS pressure		Pressurizer pressure	
	RCS inventory (trend)	None		None	
			Pressurizer inventory	Pressurizer level	
			Reactor vessel inventory	RVLMS	
	Injection water availability	RCS injection water tanks inventories		Tank levels (VCT RWST SIT)	
	(partial)	Containment sump inventory		Sump levels	

TABLE A1.10. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Initiation</u>				
Injection pump flow HPSI/LPSI/CP	Injection pump flow rate		Flow indication	
			Pump outlet pressure	
			Pump motor current	
Injection water availability (decreasing)	RCS injection water tanks inventories		Tank level (VCT RWST SIT)	
(partial)				
<u>Strategy Effectiveness</u>				
RCS inventory history	None		None	
		Pressurizer inventory	Pressurizer level	
		Reactor vessel inventory	RVLMS	

TABLE A1.10. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Selection Criteria</u>				
RCS Inventory Sources Strategies	Inventory availability	Tank inventories		Tank level (RWST SIT)	
	Pumping capability	Electric power availability			
		Steam availability			
	Alignment capability	Valve alignments		Valve position indicators	
	<u>Strategy Initiation</u>				
	Injection water inventory (decreasing)	Tank inventory		Tank level (RWST SIT)	
	Feedwater flow status	Feedwater flow rate		Feedwater flow rate	

TABLE A1.10. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Effectiveness</u>				
RCS fluid temperature	RCS fluid temperature		Hot or cold leg RTDs, CETs	
Secondary fluid inventory	Secondary liquid level		Secondary liquid level	

TABLE A1.11. PREVENT VESSEL FAILURE (V) - COOLABLE RELOCATION MECHANISM (V3A1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain vessel boundary safety function (V3)	Vessel integrity	Vessel visual observation		None	Camera for vessel observation
			Vessel wall temperature	None	Vessel temperature sensor
			RCS pressure	Pressurizer pressure	
	<u>Indicators</u>				
Coolable relocation mechanism (V3A1)	Vessel integrity	Vessel visual observation		None	Camera for vessel observation
			Vessel wall temperature	None	Vessel temperature sensor
			RCS pressure	Pressurizer pressure	
	<u>Precursors</u>				
	Core relocation status	None		None	
			Ration levels outside core region	Source range monitor	
			RCS pressure (rise)	Pressurizer pressure	
			Cold leg temperature	Cold leg RTD	

TABLE A1.11. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Precursors (continued)</u>				
Core damage status	None	Core exit temperature	Core exit thermocouples	
		Reactor vessel level	RVLMS	
		RCS coolant activity	RCS sampling system	
<u>Selection Criteria</u>				
Injection into RCS strategy	RCS pressure history	RCS pressure		Pressurizer pressure
	RCS inventory (trend)	None	Pressurizer inventory	Pressurizer level
			Reactor vessel inventory	RVLMS
Injection water availability (partial)	RCS injection water tanks inventories		Tank levels (VCT RSWT SIT)	
	Containment sump inventory		Sump levels	

TABLE A1.11. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Initiation</u>				
Injection pump flow HPSI/LPSI/CP	Injection pump flow rate		Flow indication Pump outlet pressure Pump motor current	
Injection water availability (decreasing) (partial)	RCS injection water tanks inventories		Tank level (VCT RWST SIT)	
<u>Strategy Effectiveness</u>				
RCS inventory history	None	Pressurizer inventory Reactor vessel inventory	None Pressurizer level RVLMS	
Cladding temperature	None	Core exit temperature	None Core exit thermocouples	Cladding temperature thermocouple

TABLE A1 11 (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Selection Criteria</u>				
RCS heat removal strategy using steam generator	RCS pressure (high)	RCS pressure		Pressurizer pressure	
	RCS temperature history	RCS coolant temperature		Hot or cold leg RTDs, CETs	
	RCS inventory (decreasing)	None		None	
			Pressurizer inventory	Pressurizer level	
			Reactor vessel level	RVLMS	
	Steam generator secondary pressure history	Steam generator secondary pressure		Secondary pressure	
	Steam generator inventory	Steam generator secondary level		Secondary level	
Availability		Feedwater source and alternate system feedwater status	Auxiliary, main	Status instrumentation (MFW flow AFW flow)	
		Feedwater tank inventory		Tank level (Condensate storage tank, Demineralized water storage tank)	

TABLE A1.11. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy initiation</u>				
Steam generator secondary pressure history	Steam generator secondary pressure		Secondary pressure	
Feedwater flow	Feedwater flow rate		Feedwater flow rate (MFW flow AFW flow)	
			Pump discharge pressure	
			Pump motor current	
<u>Strategy Effectiveness</u>				
RCS pressure history	RCS pressure		Pressurizer pressure	
RCS temperature history	RCS coolant temperature		Subcooled margin monitor	
			Cold and hot leg RTDs, CETs	

TABLE A1.11. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Effectiveness (continued)</u>				
	Core temperature	None		None	Cladding temperature thermocouple
			Core exit temperature	Core exit thermocouples	
	<u>Selection Criteria</u>				
RCS heat removal strategy using PORVs	RCS pressure (high)	RCS pressure		Pressurizer Pressure	
	RCS inventory (decreasing)	None		None	
			Pressurizer inventory	Pressurizer level	
			Reactor vessel inventory	RVLMS	

TABLE A1.11. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Initiation</u>				
PORV flow (confirmation)	None	RCS pressure	None	PORV flow sensor
		PORV discharge pipe temperature	Pressurizer pressure	
		PORV discharge pipe noise	PORV discharge pipe thermocouple	
		Quench tank inventory	Acoustic monitors	
			Quench tank level	
<u>Strategy Effectiveness</u>				
RCS pressure history	RCS pressure		Pressurizer pressure	
RCS temperature history	RCS coolant temperature		Subcooled margin monitor	
			Cold and hot leg RTDs, CETs	
Cladding temperature	None		None	Cladding temperature thermocouple
		Core exit temperature	Core exit thermocouples	

TABLE A2.1. PREVENT CONTAINMENT FAILURE (C)--INSUFFICIENT ENERGY REMOVAL MECHANISM (C1A1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain pressure control safety function (C1)	Containment pressure history	Containment pressure		Containment pressure	
	<u>Indicators</u>				
Insufficient energy removal mechanism (C1A1)	Imbalance in energy addition and removal	None		None	
			Containment pressure history	Containment pressure	
			Containment atmosphere temperature	Containment atmosphere temperature	
			Containment humidity	Humidity detector	
	<u>Precursors</u>				
	RCS leak integrity (status)	RCS pressure history		Pressurizer pressure	
		RCS inventory history		Pressurizer level	
				RVLMS	

TABLE A2.1. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Precursors (continued)</u>				
	Steam generator secondary system integrity (status)	Steam generator secondary pressure history		Secondary pressure	
		Steam generator secondary level history		Steam generator secondary level, Steam flow/feed flow mismatch	
	Containment heat removal systems capability (status)	Containment heat removal system equipment status		Systems flow, temperature, and pressure	
	<u>Selection Criteria</u>				
Fan cooler systems strategy	Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere temperature	
	Containment pressure history	Containment pressure record		Containment pressure	
	<u>Strategy Initiation</u>				
	Fan and cooling system operation	Fan cooling system status indicators		System status indicators	

TABLE A2.1. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Effectiveness</u>				
	Containment pressure history	Containment pressure record		Containment pressure	
	Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere temperature	
	Heat exchanger effectiveness	Fan cooling system heat exchanger differential temperature		Heat exchanger inlet and outlet temperature	
	<u>Selection Criteria</u>				
Spray systems strategy	Containment pressure history	Containment pressure		Containment pressure	
	Spray water availability	Spray water tank inventory		Tank level	
	(partial)	Containment sump inventory		Sump Level	
	Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere temperature	

TABLE A2.1. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Initiation</u>				
Containment pressure	Containment pressure		Containment pressure	
Spray flow initiation	Spray flow indicators		Pump discharge pressure	
			Pump motor current	
			Spray flow rate	
<u>Strategy Effectiveness</u>				
Containment pressure history	Containment pressure record		Containment pressure	
Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere temperature	

TABLE A2.1. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Selection Criteria</u>				
Vent strategy	Containment pressure history	Containment pressure		Containment pressure	
	Presence of radiation in containment	Containment radiation level		Containment radiation monitors	
	Containment humidity	Containment humidity		Humidity detectors	
	<u>Strategy Initiation</u>				
	Vent system initiation	Vent system flow rate			Vent system flow measurement
	<u>Strategy Effectiveness</u>				
	Containment pressure history	Containment pressure record		Containment pressure	
	Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere temperature	

TABLE A2.2. PREVENT CONTAINMENT FAILURE (C)--NONCONDENSABLE GAS BUILDUP MECHANISM (C1A2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain pressure control safety function (C1)	Containment pressure history	Containment pressure record		Containment pressure	
	<u>Indicators</u>				
Noncondensable gas buildup mechanism (C1A2)	Concentration of noncondensables (high)	Containment hydrogen concentration		Hydrogen monitoring system	
		Containment noble gas concentration		Noble gas monitoring system	
			Containment pressure	Containment pressure	
			Air and nitrogen equipment status	Equipment status indicators	
	<u>Precursors</u>				
	RCS leak integrity (status)	RCS pressure history		RCS pressure	
		RCS inventory history		Pressurizer level	
				RVLMS	

TABLE A2.2. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Precursors (continued)</u>				
	Core damage status	None	Core exit temperature	None	Core exit thermocouples
			Reactor vessel inventory	RVLMS	
			RCS coolant activity	RCS sampling system	
	<u>Selection Criteria</u>				
Vent strategy	Containment pressure history	Containment pressure record		Containment pressure	
	Hydrogen gas concentration	Containment hydrogen concentration		Hydrogen gas monitor	
	Noble gas concentration	Containment noble gas concentration		Noble gas monitor	
	Presence of radiation in containment	Containment radiation level		Containment radiation monitors	
	Containment humidity	Containment humidity		Humidity detectors	

TABLE A2.2. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Initiation</u>				
	Vent system flow	Vent system flow rate			Vent system flow measurement
	<u>Strategy Effectiveness</u>				
	Containment pressure history	Containment pressure record		Containment pressure	
	Hydrogen gas concentration	Containment hydrogen concentration		Hydrogen gas monitor	
	Noble gas concentration	Containment noble gas concentration		Noble gas monitor	
	<u>Selection Criteria</u>				
Recombiners/ igniters strategy	Containment pressure history	Containment pressure record		Containment pressure	
	Hydrogen gas concentration	Containment hydrogen concentration		Hydrogen gas monitor	

TABLE A2.2. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Initiation</u>				
Initiation of recombiners/ igniters	Recombiners/ igniters equipment status		Status indicators	
<u>Strategy Effectiveness</u>				
Hydrogen gas concentration	Containment hydrogen concentration		Hydrogen gas monitor	
Containment pressure history	Containment pressure record		Containment pressure	

TABLE A2.3. PREVENT CONTAINMENT FAILURE (C)--DIRECT CONTAINMENT HEATING MECHANISM (C1B1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain pressure control safety function (C1)	Containment pressure history	Containment pressure		Containment pressure	
	<u>Indicators</u>				
Direct containment heating mechanism (C1B1)	Containment pressure history	Containment Pressure record		Containment pressure	
	Containment temperature history	Containment atmosphere temperature		Containment thermocouples	
	Containment radiation level	Containment radiation level		Containment radiation monitor	
	<u>Precursors</u>				
	RCS pressure (high)	RCS pressure		Pressurizer pressure	
	Approach to vessel failure	Vessel visual observation		None	Camera for vessel observation
			Vessel wall temperature	None	Vessel temperature sensor
			RCS pressure	Pressurizer pressure	

TABLE A2.3. (continued)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments
<u>Information Needs</u>					
<u>Precursors (continued)</u>					
	Core damage status	None		None	
			Core exit temperature	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
			RCS coolant activity	RCS sampling system	
<u>Selection Criteria</u>					
Depressurize RCS strategy	RCS pressure history	RCS pressure		Pressurizer pressure	
	Steam generator heat removal capability	Steam generator secondary pressure		Steam generator pressure	
	(partial)	Steam generator secondary level		Steam generator liquid level	
		Feedwater tank inventory		Tank levels	
		Auxiliary, main and alternate feed- water system status		Equipment status (MFW flow AFW flow)	

TABLE A2.3. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Selection Criteria (continued)</u>				
Core damage status	None	Core exit temperature	Core exit thermocouples	
		Reactor vessel inventory	RVLMS	
		RCS coolant activity	RCS sampling system	
<u>Strategy Initiation</u>				
RCS pressure history	RCS pressure		Pressurizer pressure	
Steam generator secondary pressure	Steam generator secondary pressure		Steam generator pressure	
PORV flow (confirmation)		PORV discharge Pipe temperature	PORV discharge pipe thermocouple	
		PORV flow	Acoustic monitors	
		Quench tank inventory	Quench tank level	

TABLE A2.3. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Effectiveness</u>				
	RCS pressure	RCS pressure		Pressurizer pressure	
	Containment pressure	Containment pressure		Containment pressure	
	<u>Selection Criteria</u>				
Vent strategy	Containment pressure	Containment pressure		Containment pressure	
	RCS pressure	RCS pressure		RCS pressure	
	Core damage status	None		None	
			Core exit temperature	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
			RCS coolant activity	RCS sampling system	
	Presence of radiation in containment	Containment radiation level		Containment radiation monitors	

TABLE A2.3. (continued)

	<u>Information Needs</u>	Direct	Indirect	Available	Potential
		Information	Information	Instruments	Instruments
		Source	Source		
	<u>Strategy Initiation</u>				
	Vent system flow	Vent system flow rate		Vent system flow measurement	
	<u>Strategy Effectiveness</u>				
	Containment pressure	Containment pressure		Containment pressure	
	<u>Selection Criteria</u>				
Flood cavity strategy	RCS pressure	RCS pressure		Pressurizer pressure	
	Core damage status	None		None	
			Core exit temperature	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
			RCS coolant activity	RCS sampling system	
	Cavity inventory	Cavity inventory		None	Cavity level sensor
	Inventory available to flood cavity	Cavity flooding system tank inventory			Tank levels

TABLE A2.3. (continued)

<u>Information Needs</u>		<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Initiation</u>					
	Flow to cavity	Cavity flooding system			Flow measurement
	Inventory available to flood cavity	Cavity flooding system inventory			Tank levels
<u>Strategy Effectiveness</u>					
	Containment pressure	Containment pressure		Containment pressure	
<u>Selection Criteria</u>					
Add barriers strategy	None-passive system				
<u>Strategy Initiation</u>					
	None-passive system				

TABLE A2.4. PREVENT CONTAINMENT FAILURE (C)--COMBUSTABLE GAS DETONATION MECHANISM (C1B2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Effectiveness</u>				
Maintain pressure control safety function (C1)	Containment pressure	Containment pressure		Containment pressure	
	Containment Pressure history	Containment pressure		Containment pressure	
	<u>Indicators</u>				
Combustible gas detonation mechanism (C1B2)	Containment pressure history	Containment pressure		Containment pressure	
	Containment atmosphere temperature history	Containment atmosphere temperature		Containment temperature	
	<u>Precursors</u>				
	Hydrogen gas concentration (increasing)	Containment hydrogen concentration		Hydrogen monitoring system	
	Containment radiation level	Containment radiation		Containment radiation monitors	
	Core damage	None		None	
			Core exit temperature	Core exit thermocouples	

TABLE A2.4. (continued)

<u>Information Needs</u>		<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Precursors (continued)</u>					
			Reactor vessel level	RVLMS	
			RCS coolant activity	RCS sampling system	
<u>Selection Criteria</u>					
Recombiners/ igniters strategy	Hydrogen gas concentration	Containment hydrogen concentration		Hydrogen monitoring system	
	Containment pressure history	Containment pressure		Containment pressure	
<u>Strategy Initiation</u>					
	Initiation of recombiners/ igniters	Recombiners/ igniters equipment status		Status indicator	

TABLE A2.4. (continued)

	<u>Information Needs</u>	<u>Direct</u>	<u>Indirect</u>	<u>Available</u>	<u>Potential</u>
		<u>Information</u>	<u>Information</u>	<u>Instruments</u>	<u>Instruments</u>
		<u>Source</u>	<u>Source</u>		
	<u>Strategy Effectiveness</u>				
	Hydrogen gas concentration	Containment hydrogen concentration		Hydrogen monitoring system	
	Containment pressure history	Containment pressure		Containment pressure	
	<u>Selection Criteria</u>				
Vent strategy	Hydrogen gas concentration	Containment hydrogen concentration		Hydrogen monitoring system	
	Containment pressure	Containment pressure		Containment pressure	
	Presence of radiation in containment	Containment radiation level		Containment radiation monitors	

TABLE A2.4. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Initiation</u>				
Vent system flow	Vent system flow rate			Vent system flow measurement
<u>Strategy Effectiveness</u>				
Hydrogen gas concentration	Containment hydrogen concentration		Hydrogen monitoring system	
Containment pressure	Containment pressure		Containment pressure	

TABLE A2.5. PREVENT CONTAINMENT FAILURE (C)--STEAM EXPLOSION MECHANISM (C1B3)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain pressure control safety function (C1)	Containment pressure history	Containment pressure		Containment pressure	
	<u>Indicators</u>				
Steam explosion mechanism (C1B3)	Containment pressure history	None	Containment pressure	Containment pressure	
	Containment atmosphere temperature history	None	Containment atmosphere temperature	Containment thermocouples	
	Containment radiation level	None	Containment radiation level	Containment radiation monitors	
	<u>Precursors</u>				
	Vessel integrity	Vessel visual observation		None	Camera for vessel observation
			Vessel wall temperature	None	Vessel temperature sensor
			RCS (vessel) pressure	Pressurizer pressure	
	Core relocation status	None		None	
			Radiation levels outside core region	Source range monitors	

TABLE A2.5. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Precursors (continued)</u>				
	Core damage status	None	Core exit temperature	Core exit thermocouples	
			Reactor vessel level	RVLMS	
			RCS coolant activity	RCS sampling	
	Water in Cavity	Cavity inventory	None	None	Cavity level sensor
	<u>Selection Criteria</u>				
Eliminate water strategy	Cavity inventory	Cavity inventory		None	Cavity level sensor
	Core damage status	None		None	
			Core exit temperature	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
			RCS coolant activity	RCS sampling system	

TABLE A2.5. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Initiation</u>				
Water flow from cavity	Cavity drain system flow rate			Flow measurement
<u>Strategy Effectiveness</u>				
Cavity water inventory	Cavity inventory		None	
Containment pressure	Containment pressure		Containment pressure	
<u>Selection Criteria</u>				
Add barriers strategy	None-passive system			
<u>Strategy Initiation</u>				
None-passive system				
<u>Strategy Effectiveness</u>				
Containment pressure	Containment pressure		Containment pressure	

TABLE A2.6. PREVENT CONTAINMENT FAILURE (C)--ENERGY ADDITION AT VESSEL FAILURE MECHANISM (C1B4)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain pressure control safety function (C1)	Containment pressure history	Containment pressure		Containment pressure	
	<u>Indicators</u>				
Energy Addition at vessel failure mechanism (C1B4)	Containment pressure history	Containment pressure record		Containment pressure	
	Containment atmosphere temperature history	Containment atmosphere temperature		Containment thermocouples	
	Containment radiation level	Containment radiation level		Containment radiation monitor	
	<u>Precursors</u>				
	RCS Pressure (high)	RCS pressure		Pressurizer pressure	
Prevent vessel failure strategy	See Table A1.11, RCS heat removal strategies using steam generator and PORV and injection into RCS strategy to prevent vessel failure.				
Insufficient energy removal strategy	See Table A2.1, spray system, fan cooler, and vent strategies to reduce pressure prior to vessel failure.				

TABLE A2.7. PREVENT CONTAINMENT FAILURE (C)--TEMPERATURE INDUCED DEGRADATION MECHANISM (C2A1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain temperature control safety function (C2)	Containment shell temperature history	None	Containment atmosphere temperature	None Containment atmosphere thermocouples	Containment shell temperature sensor
	<u>Indicators</u>				
Temperature induced degradation mechanism (C2A1)	Containment penetration integrity	None	Containment penetration temperature	None None	Penetration temperature sensor
	<u>Precursors</u>				
	High containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere thermocouple	
	<u>Selection Criteria</u>				
Fan cooler systems strategy	Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere thermocouple	
	<u>Strategy Initiation</u>				
	Fan and cooling system operation	Fan cooling system status		System status indicators	

TABLE A2.7. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Effectiveness</u>				
	Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere thermocouple	
	<u>Selection Criteria</u>				
Spray systems strategy	Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere thermocouple	
	Spray water availability	Spray water tank inventory		Tank level	
	(partial)	Sump level		Sump level	
	<u>Strategy Initiation</u>				
	Spray flow	Spray flow indicators		Spray flow indication	
				Pump discharge pressure	
				Pump motor current	
	<u>Strategy Effectiveness</u>				
	Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere thermocouple	

TABLE A2.8. PREVENT CONTAINMENT FAILURE (C)--CORE/CONCRETE INTERACTION MECHANISM (C2B1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain temperature control safety function (C2)	Containment temperature history	Containment temperature		Containment atmosphere and wall temperature	
	<u>Indicators</u>				
Core/basemat concrete interaction mechanism (C2B1)	Amount of concrete ablated	Basemat temperature profile		None	
	<u>Precursors</u>				
	Vessel integrity status	High vessel wall temperature	Radiation level	None Source range monitor	Vessel temperature sensor
	Core damage status	None	Core exit temperature Reactor vessel inventory RCS coolant activity	None Core exit thermocouples RVLMS RCS sampling system	

TABLE A2.8. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Selection Criteria</u>				
Flood cavity strategy	Core damage status	None		None	
			Core exit temperature	Core exit thermocouples	
			Reactor vessel level	RVLMS	
			RCS coolant activity	RCS sampling	
	Cavity inventory	Cavity inventory		None	Cavity level sensor
	Inventory available to flood cavity	Cavity flooding system tank inventory			Tank levels
	<u>Strategy Initiation</u>				
	Flow to cavity	Cavity flooding system flow rate			Flow measurement
	Inventory available to flood cavity	Cavity flooding system tank inventory			Tank levels

TABLE A2.8. (continued)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments
<u>Information Needs</u>					
<u>Strategy Effectiveness</u>					
	Basemat integrity	None		None	
			Containment pressure history	Containment pressure	
<u>Selection Criteria</u>					
Add barriers strategy	None-passive system				
<u>Strategy Initiation</u>					
	None-passive system				
<u>Strategy Effectiveness</u>					
	Basemat integrity	None		None	
			Containment pressure history	Containment pressure	

TABLE A2.9. PREVENT CONTAINMENT FAILURE (C)--FAILURE TO ISOLATE MECHANISM (C3A1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain integrity safety function (C1)	Containment leak rate	None		None	
			Containment pressure history	Containment pressure	
			Radiation level outside containment	Radiation monitoring system	
	Containment Leak location	None		None	
			Radiation location outside Containment	Radiation monitoring system	
	<u>Indicators</u>				
Failure to isolate mechanism (C3A1)	Containment isolation system failure location	Containment isolation system status		Containment isolation system status	
			Containment pressure history	Containment pressure	
			Radiation level outside containment	Radiation monitoring system	

TABLE A2.9. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Precursors</u>				
	Core damage status	None		None	
			RCS coolant activity	Sampling system	
			Core exit temperature history	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
	Containment radiation level	Containment radiation level		Containment radiation monitor	
Plant-specific isolation response strategy	Valve position	Plant dependant	Plant dependant	Plant dependant	
	<u>Selection Criteria</u>				
Spray systems strategy	Containment pressure history	Containment pressure		Containment pressure	
	Spray water availability	Spray water tank inventory		Tank level	
	(partial)	Containment sump inventory		Sump Level	

TABLE A2.9. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Selection Criteria (continued)</u>				
Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere temperature	
<u>Strategy Initiation</u>				
Containment pressure	Containment pressure		Containment pressure	
Spray flow initiation	Spray flow indicators		Pump discharge pressure	
			Pump motor current	
			Spray flow rate	
<u>Strategy Effectiveness</u>				
Containment pressure history	Containment pressure record		Containment pressure	
Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere temperature	

TABLE A2.9. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Selection Criteria</u>				
Vent strategy	Containment pressure history	Containment pressure		Containment pressure	
	Presence of radiation in containment	Containment radiation level		Containment radiation monitors	
	Containment humidity	Containment humidity		Humidity detectors	
	<u>Strategy Initiation</u>				
	Vent system initiation	Vent system flow rate			Vent system flow measurement
	<u>Strategy Effectiveness</u>				
	Containment pressure history	Containment pressure record		Containment pressure	
	Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere temperature	

TABLE A2.10. PREVENT CONTAINMENT FAILURE (C)--FAILURE AFTER ISOLATION MECHANISM (C3A2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain integrity safety function (C1)	Containment leak rate	None		None	
			Containment pressure history	Containment pressure	
			Radiation level outside containment	Radiation monitoring system	
	Containment leak location	None		None	
			Radiation location outside containment	Radiation monitoring system	
	<u>Indicators</u>				
Failure after isolation mechanism (C3A2)	Containment isolation system failure location	Containment isolation system status		Containment isolation system status	
			Radiation level outside containment	Radiation monitoring system	
			Containment pressure history	Containment pressure	

TABLE A2.10. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Precursors</u>				
	Core damage status	None		None	
			RCS coolant activity	Sampling system	
			Core exit temperature history	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
	<u>Selection Criteria</u>				
Reisolation strategy	Containment isolation valve position status	Containment isolation valve status		Valve position indicators	
	<u>Strategy Initiation</u>				
	Containment isolation valves closed	Containment isolation valve status		Valve position indicators	
	<u>Strategy Effectiveness</u>				
	Decrease in magnitude of fission product release	Radiation outside containment		Radiation area monitors	

TABLE A2.10. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Selection Criteria</u>				
Depressurize containment strategy	Reisolation not possible		Containment isolation valve status	Valve position indicators	
	Fission products in containment atmosphere	Containment radiation level		Radiation monitoring system	
	Containment pressure	Containment pressure		Containment pressure	
	<u>Strategy Initiation</u>				
	See Table A2.1 for spray, fan cooler, and venting strategies.				
	<u>Strategy Effectiveness</u>				
	Decrease in magnitude of fission product release	Radiation outside containment		Radiation area monitors	

TABLE A2.10. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Selection Criteria</u>				
Flood containment leak strategy	Leak point can be located and flooded	Containment leak location			Visual or camera
	<u>Strategy Initiation</u>				
	Flow to leak location	Flow in leak flooding system			Flow meter
	<u>Strategy Effectiveness</u>				
	Decrease in magnitude of fission product release	Radiation outside containment		Radiation monitors	

TABLE A2.11. MITIGATE FISSION PRODUCT RELEASE (F)--STEAM GENERATOR TUBE RUPTURE FAILURE MECHANISM (C3B1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain integrity safety function (C1)	Containment leak rate	None		None	
			Containment pressure history	Containment pressure	
			Radiation level outside containment	Radiation monitoring system	
	Containment leak location	None		None	
			Radiation location outside containment	Radiation monitoring system	
<u>Indicators</u>					
SGTR mechanism (C3B1)	Presence of fission products in steam line	Main steam line radiation level		Steam line radiation monitoring system	
			Condenser off gas radiation level		Condenser off gas radiation monitoring system
			Radiation outside containment		Radiation surveys, constant air monitor

TABLE A2.11. (continued)

	<u>Information Needs</u>	Direct	Indirect	Available	Potential
		<u>Information</u> <u>Source</u>	<u>Information</u> <u>Source</u>	<u>Instruments</u>	<u>Instruments</u>
A-93	<u>Precursors</u>				
	Core damage status	None		None	
			RCS coolant activity	None	
			Core exit temperature history	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
	<u>Selection criteria</u>				
	Depressurize RCS strategy	RCS pressure greater than ruptured generator (partial)	RCS pressure Steam generator secondary pressure	Pressurizer pressure Steam generator pressure	
	<u>Strategy Initiation</u>				
	RCS cooldown with intact generator(s)	Steam flow rate RCS coolant temperature		Steam flow indicators cold leg RTDs, core exit thermocouples	
			Steam generator secondary pressure	Pressure in intact steam generator	

TABLE A2.11. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Initiation (continued)</u>				
	PORV open	PORV position		PORV status indicator	
	<u>Strategy Effectiveness</u>				
	RCS pressure decreasing	RCS pressure		Pressurizer pressure	
	<u>Selection Criteria</u>				
Flood steam generator secondary strategy	Low steam generator inventory	Steam generator secondary level		Steam generator level indicator	
	<u>Strategy Initiation</u>				
	Flow to steam generator	Auxiliary feedwater flow rate		Auxiliary feedwater flow indication	
	<u>Strategy Effectiveness</u>				
	Increasing steam generator inventory	Steam generator secondary level		Steam generator level indication	

TABLE A2.12. PREVENT CONTAINMENT FAILURE (C)--ISLOCA MECHANISM (C3B2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain integrity safety function (C1)	Containment leak rate	None		None	
			Containment pressure history	Containment pressure	
			Radiation level outside containment	Radiation monitoring system	
	Containment leak location	None		None	
			Radiation location outside containment	Radiation monitoring system	
<u>Indicators</u>					
ISLOCA mechanism (C3B2)	Presence of containment bypass and fission product release	None		None	
			Radiation outside containment	Radiation monitoring system	
			RCS pressure	RCS pressure	
			RCS inventory	Pressurizer level	
				RVLMS	
			Decreased RCS subcooled margin	RCS subcooling monitoring	

TABLE A2.12. (continued)

	<u>Information Needs</u>		<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Isolate rupture strategy	<u>Indicators (continued)</u>					
				Containment pressure	Containment pressure	
				Containment inventory	Sump level	
	<u>Precursors</u>					
	Core damage status	None		RCS coolant activity	None Sampling system	
				Core exit temperature history	Core exit thermocouples	
				Reactor vessel inventory	RVLMS	
	<u>Selection Criteria</u>					
	Rupture location	None			None	
				Interfacing system conditions	System status indicators	
				Visual surveillance of systems outside containment	Visual	

TABLE A2.12. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Initiation</u>				
	Closure of isolation valve		Containment isolation valve status	Valve position indicator	
	<u>Strategy Effectiveness</u>				
	Stabilized RCS conditions	RCS pressure		Pressurizer pressure	
		RCS inventory		Pressurizer level RVLMS	
		RCS subcooling		RCS subcooled margin monitor	
	<u>Selection Criteria</u>				
Depressurize RCS strategy	Excess RCS pressure	RCS pressure		RCS pressure	
	<u>Strategy Initiation</u>				
	RCS cooldown with steam generators	RCS pressure		RCS pressure	
			Steam generator secondary pressure	Pressure in steam generators	
	Open PORV	PORV position		PORV status indicator	

TABLE A2.12. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Effectiveness</u>				
	Increase in rate of RCS depressurization	RCS pressure		Pressurizer pressure	
	<u>Selection Criteria</u>				
Flood break location strategy	Leak point can be flooded	Visual surveillance of systems outside containment			Visual
	<u>Strategy Initiation</u>				
	Flow to break location	Flow in break flooding system			Flow indication
	<u>Strategy Effectiveness</u>				
	Decrease in magnitude of fission product release	Radiation outside containment		Radiation monitors	

TABLE A2.13. PREVENT CONTAINMENT FAILURE (C)--STEAM EXPLOSION MISSILE MECHANISM (C3C1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain integrity safety function (C1)	Containment leak rate	None		None	
			Containment pressure history	Containment pressure	
			Radiation level outside containment	Radiation monitoring system	
		Containment leak location	None		None
				Radiation location outside containment	Radiation monitoring system
	<u>Indicators</u>				
Steam explosion missile mechanism (C3C1)	Penetration of containment by a missile	Containment visual observation		None	
			Containment pressure	Containment pressure	
	<u>Precursors</u>				
	Rapid core relocation at low pressure		RCS pressure	RCS pressure	
	Core damage status	None		None	

TABLE A2.13. (continued)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments
<u>Information Needs</u>					
<u>Precursors (continued)</u>					
			Core exit temperature	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
			RCS coolant activity	RCS sampling system	
	Presence of water in lower plenum	Lower plenum water level		None	Lower plenum level sensor
<u>Selection Criteria</u>					
Add barriers strategy	None-passive system				
<u>Strategy Initiation</u>					
	None-passive system				
<u>Strategy Effectiveness</u>					
	Containment integrity	None		None	
			Containment pressure	Containment pressure	

TABLE A2.13. (continued)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments
<u>Strategy Effectiveness (continued)</u>					
			Radiation outside containment	Radiation monitoring system	
<u>Selection Criteria</u>					
Dry vessel strategy	Core damage status	None		None	
			Core exit temperature	Core Exit thermocouples	
			Reactor vessel inventory	RVLMS	
			RCS coolant activity	RCS sampling system	
	Lower plenum inventory	Lower plenum water level		None	Lower plenum level sensor
<u>Strategy Initiation</u>					
	Lower plenum inventory	Lower plenum water level		None	Lower plenum level sensor

TABLE A2.13. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Strategy Effectiveness</u>				
	Containment integrity	None	Containment pressure	None	Containment pressure
	<u>Selection Criteria</u>				
RCS at high pressure strategy	RCS pressure	RCS pressure		Pressurizer pressure	
	Core damage status	None		None	
			Core exit temperature	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
			RCS coolant activity	RCS sampling system	

TABLE A2.13. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Initiation</u>				
RCS pressure	RCS pressure		Pressurizer pressure	
<u>Strategy Effectiveness</u>				
RCS pressure	RCS pressure		Pressurizer pressure	
Containment pressure	Containment pressure		Containment pressure	

TABLE A2.14. PREVENT CONTAINMENT FAILURE (C)--HYDROGEN DETONATION MISSILE MECHANISM (C3C2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain integrity safety function (C1)	Containment leak rate	None		None	
			Containment pressure history	Containment pressure	
			Radiation level outside containment	Radiation monitoring system	
	Containment leak location	None		None	
			Radiation location outside containment	Radiation monitoring system	
	<u>Indicators</u>				
Hydrogen detonation missile mechanism (C3A2)	Penetration of containment by a missile	Containment visual observation		None	
			Containment pressure	Containment pressure	
	<u>Precursors</u>				
	Increasing hydrogen gas concentration	Containment hydrogen concentration		Hydrogen monitoring system	

TABLE A2.14. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Precursors (continued)</u>				
Core damage status	None	Core exit temperature	None	Core exit thermocouples
		Reactor vessel inventory	RVLMS	
		RCS coolant activity	RCS sampling system	
<u>Selection Criteria</u>				
Add barriers strategy	None-passive system			
<u>Strategy Initiation</u>				
	None-passive system			

TABLE A2.14. (continued)

	<u>Information Needs</u>	Direct	Indirect	Available	Potential
		Information Source	Information Source	Instruments	Instruments
	<u>Strategy Effectiveness</u>				
	Containment integrity	None		None	
			Containment pressure	Containment pressure	
			Radiation outside containment	Radiation monitoring system	
	<u>Selection Criteria</u>				
Prevent hydrogen explosion strategy	See Table A2.4 strategies.				
	<u>Strategy Initiation</u>				
	See Table A2.4 strategies.				
	<u>Strategy Effectiveness</u>				
	See Table A2.4 strategies.				

TABLE A3.1. MITIGATE FISSION PRODUCT RELEASE FROM CONTAINMENT (F)--AEROSOL DISPERSION MECHANISM (F1A1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain control of fission product inventory in containment atmosphere safety function (F1)	Presence of fission products in containment atmosphere	Containment radiation level		Radiation (CONT) monitoring system, noble gas monitoring system	
	<u>Indicators</u>				
aerosol dispersion mechanism (F1A1)	Presence of aerosols in containment atmosphere	None	Containment radiation level	None Radiation monitoring system Noble gas monitoring system	
	<u>Precursors</u>				
	Core damage status	None	RCS coolant activity Core exit temperature history Reactor vessel inventory	None Sampling system Core exit thermocouples RVLMS	

TABLE A3.1. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Selection Criteria</u>				
Spray/ additives strategy	Fission products in containment	None		None	
			Containment radiation level	Radiation monitoring system	
	<u>Strategy Initiation</u>				
	Flow in spray system	Spray flow		Spray flow	
	<u>Strategy Effectiveness</u>				
	Decreased containment radiation level	None		None	
			Containment radiation level	Radiation monitoring system	
	<u>Selection Criteria</u>				
Filter system strategy	Fission product in containment atmosphere	None		None	
			Containment radiation level	Radiation monitoring system	
	<u>Strategy Initiation</u>				
	Activation of filter fans	Filter fan system status		Fan status	

TABLE A3.1. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Chemical reaction strategy	<u>Strategy Effectiveness</u>				
	Decreased containment radiation level		Containment radiation level	Radiation monitoring system	
	<u>Selection Criteria</u>				
	None-passive system				
	<u>Strategy Initiation</u>				
	None-passive system				
	<u>Strategy Effectiveness</u>				
	Low containment radiation level	None		None	
			Containment radiation level	Radiation monitoring system	

TABLE A3.2. MITIGATE FISSION PRODUCT RELEASE FROM CONTAINMENT (F)--GASEOUS DISPERSION MECHANISM (F1A2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain control of fission product inventory in containment atmosphere safety function (F1)	Presence of fission products in containment atmosphere	Containment radiation level		Radiation (CONT) monitoring system, noble gas monitoring system	
	<u>Indicators</u>				
Gaseous dispersion mechanism (F1A2)	Presence of fission product gases in containment atmosphere	None	Containment radiation levels	Radiation monitoring system Noble gas monitoring system	
	<u>Precursors</u>				
	Core damage status	None	RCS coolant activity Core exit temperature history Reactor vessel inventory	None Sampling system Core exit thermocouples RVLMS	

TABLE A3.2. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Selection Criteria</u>					
Chemical reactions strategy	Presence of fission product gases in containment atmosphere	None		None	
			Containment radiation levels	Radiation monitoring system	
<u>Strategy Initiation</u>					
	Containment circulation system operating	Containment circulation		System (fan cooling) status system status	
<u>Strategy Effectiveness</u>					
	Reduced concentration of fission product gases in containment atmosphere	None		None	
			Containment radiation level	Radiation monitoring	
<u>Selection Criteria</u>					
Cryogenic system strategy	Presence of fission product gases in containment atmosphere		Containment radiation levels	Radiation monitoring system	
		Containment noble gas concentration		Noble gas monitoring system	

TABLE A3.2. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Strategy Initiation</u>				
Cryogenic system operating	Cryogenic system status			System status
<u>Strategy effectiveness</u>				
Reduced concentration of fission product gases in containment atmosphere		Containment radiation	Radiation monitoring system	
	Containment noble gas concentration		Noble gas monitoring system	

TABLE A3.3. MITIGATE FISSION PRODUCT RELEASE (F)--pH TOO-LOW MECHANISM (F2A1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain control of fission product release from containment water safety function (F2)	Presence of fission products in containment water	Containment sump water chemistry		Sump water sampling system	
			Containment radiation level	Radiation monitoring system	
	<u>Indicators</u>				
pH too-low mechanism (F2A1)	Containment water pH presence of iodine	Containment sump water chemistry		Accident sampling system	
	<u>Precursors</u>				
	Core damage	None		None	
			RCS coolant activity	Sampling system	
			Core exit temperature history	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	

TABLE A3.3. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Selection Criteria</u>				
Add base strategy	Amount of contaminated water	None	Containment sump inventory	Sump level indicator	
	Availability of basic solution	None	Supply of chemicals for base solution	None	Tank levels
	<u>Strategy Initiation</u>				
	Flow of basic solution	Flow in system for adding base to containment water			Flow indicator
	<u>Strategy Effectiveness</u>				
	Increase in containment water pH	Containment sump water chemistry		Accident sampling system	

TABLE A3.3. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Selection Criteria</u>				
Dilution strategy	Amount of contaminated water	None	Containment sump inventory	None Sump level indicator	
	Inventory of dilution liquid	Dilution system tank level			Level indicator
	<u>Strategy Initiation</u>				
	Flow of dilution liquid to containment waste	Flow in dilution system			Flow indicator
	<u>Strategy Effectiveness</u>				
	Increase in containment water pH	Containment sump water chemistry		Accident sampling system	

TABLE A3.4. MITIGATE FISSION PRODUCT RELEASE FROM CONTAINMENT (F)--RIOLYSIS MECHANISM (F23A2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain control of fission product release from containment water safety function (F23)	Presence of fission products in containment water	Sump water radiation level		Sump water sampling system	
	<u>Indicators</u>				
Radiolysis mechanism (F23A2)	Presence of radiolytic products	None	Containment atmosphere sampling	None Sampling system	
	<u>Precursors</u>				
	Core damage status	None	RCS coolant activity Core exit temperature history Reactor vessel inventory	None Sampling system Core exit thermocouples RVLMS	

TABLE A3.4. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
	<u>Precursors (continued)</u>				
	Water available for radiolysis	None		None	
			Reactor vessel level	RVLMS	
			Cavity inventory	None	
	<u>Selection Criteria</u>				
Dilution strategy	Availability of dilution water	Dilution system tank level			Tank level indicators
	<u>Strategy Initiation</u>				
	Flow of water to damaged core	Injection pump flow			Flow indicator
	<u>Strategy Effectiveness</u>				
	Water level above core	Reactor vessel inventory		RVLMS	

TABLE A3.5. MITIGATE FISSION PRODUCT RELEASE FROM CONTAINMENT (F)--EXCESSIVE WATER TEMPERATURE MECHANISM (F2A3)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
Maintain control of fission product release from containment water safety function (F2)	Presence of fission products in containment water	Sump water radiation level		Sump water sampling system	
	<u>Indicators</u>				
Excessive water temperature mechanism (F2A3)	Sump water temperature	Sump water temperature		Sump water temperature	
	<u>Precursors</u>				
	Inadequate heat removal from sump water	None		None	
			Sump water temperature	Sump water temperature indicators	
			Sump water cooling heat exchanger outlet temperature	Temperature indicators	

TABLE A3.5. (continued)

<u>Information Needs</u>		<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
<u>Precursors (continued)</u>					
	Core damage status	None		None	
			RCS coolant activity	Sampling system	
			Core exit temperature history	Core exit thermocouples	
			Reactor vessel inventory	RVLMS	
<u>Selection Criteria</u>					
Cooling system strategy	Sump water temperature	Sump water temperature		Sump Water temperature indicators	
	Operation of containment heat removal systems	Status of containment heat removal systems		Temperature and flow indicators	
<u>Strategy Initiation</u>					
	Operation of sump water cooling system	Status of sump water cooling system		Temperature and flow indicators	

TABLE A3.5. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>
A-120	<u>Strategy Effectiveness</u>				
	Reduction in sump water temperature	Sump water temperature		Sump water temperature indications	
			Heat exchanger outlet temperature	Outlet temperature indicator	
	<u>Selection Criteria</u>				
	Add cooler water strategy	Sump water temperature	Sump water temperature	Sump water temperature indicators	
	Inventory of water to fill sump	Sump fill system tank level			Tank level indicators
	<u>Strategy Initiation</u>				
	Flow of water to sump	Flow rate in sump fill system			Flow indicator
	Increase in containment sump inventory	Containment sump inventory		Sump level indicator	
	<u>Strategy effectiveness</u>				
	Reduction in containment water temperature	Sump water temperature		Sump water temperature indicator	

APPENDIX B

**PLANT-SPECIFIC MEASUREMENTS
COMPARED TO REGULATORY GUIDE 1.97**

APPENDIX B

PLANT-SPECIFIC MEASUREMENTS COMPARED TO REGULATORY GUIDE 1.97

The tables contained in Appendix B were developed to summarize the availability of *plant-specific* measurements for accident management and the requirements for their qualification. Tables B1, B2, and B3 list the existing measurements according to that contained in Regulatory Guide 1.97. Regulatory Guide 1.97 specifies a method acceptable to the NRC staff for providing instrumentation to monitor plant variables during and following an accident in a light-water-cooled nuclear power plant. Regulatory Guide 1.97 specifies three different categories of qualification:

Category 1 provides for full qualification, redundancy, and continuous real-time display and requires onsite (standby) power. Category 2 provides for qualification but is less stringent in that it does not (of itself) include seismic qualification, redundancy, or continuous display and requires only a high-reliability power source (not necessarily standby power). Category 3 is the least stringent. It provides for high-quality commercial-grade equipment that requires only off-site power.

Table B1 in Appendix B lists those existing measurements from Category 1 as specified in Regulatory Guide 1.97. Similarly, Tables B2 and B3 list existing measurements from Category 2 and Category 3, respectively. These tables represent a Combustion Engineering 2700 Mwt plant such as Calvert Cliffs Units 1 and 2 or Millstone Unit 2. Columns are provided in these tables to list information regarding current requirements for environmental qualification for the specific measurement, and the location of the sensor (in the reactor, auxiliary building, containment, turbine building, etc.). It is important to note that representative containment harsh environments include a maximum pressure of 60 psia and a maximum temperature of 300°F and are generally associated with the design basis loss-of-coolant accident. Some instruments are required for other design basis (DB) accidents which do not include harsh environments. To identify the two potential environments, these requirements are denoted as DBA Harsh and DBA non-Harsh in the table. This information will be used to determine the survivability of the instruments in the environment that can be expected during a severe accident sequence.

TABLE B1. PLANT-SPECIFIC MEASUREMENTS COMPARED TO REGULATORY GUIDE 1.97--CATEGORY 1

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
Radiation levels outside core region	Core relocation status	Source range monitor 10^{-1} to 10^5 CPS 10^{-9} to $10^{-3}\%$	DBA non-harsh	Reactor cavity	AVI	FEC	FEC	FEC
	Vessel failure status	full power						
	Passage of core material across boundary	Neutron flux wide range 10^{-8} to 150% full power Power range 0.1 to 125% full power	DBA non-harsh	Reactor/reactor cavity	AVI	FEC	FEC	FEC
B-4 RCS coolant activity	Core damage status	Primary coolant and sump gross activity	DBA non-harsh	Auxiliary building	AVI	AVI	AVI	AVI
	Fuel rod cladding condition	$1\mu\text{Ci/mL}$ -10 Ci/mL						
	Fuel rod geometry	Primary coolant gamma spectrum (gamma emitting isotopes 80 keV to 3 MeV)	DBA non-harsh	Auxiliary building	AVI	AVI	AVI	AVI
	Cladding temperature							
	Quantity of fission products being dispersed from RCS and location	Primary coolant radiation monitor 0-10 CPM	DBA non-harsh	Auxiliary building	AVI	AVI	AVI	AVI
Core exit temperature	Core temperature	200-2300°F	DBA harsh	Reactor	AVI	FEC	FEC	FEC
	Cladding temperature							
	Core damage status							

TABLE B1. (continued)

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
Reactor vessel inventory	Cladding oxidation status							
	Fuel rod cladding condition							
	Water level above core	0-100% level above core (RVLMS)	DBA harsh	Reactor	AVI	FEC	FEC	FEC
	RCS inventory							
	RCS leak integrity (status)							
	Core damage status							
	Cladding temperature							
	Core temperature							
Pressurizer inventory	Water available for radiolysis							
	RCS inventory	0-360 in. 0-100% pressurizer level	DBA harsh	Containment and RCS	AVI	FEC	FEC	FEC (T&P)
	RCS leak integrity (status)							
Coolant hydrogen concentration	Cladding oxidation	Primary coolant and sump Dissolved hydrogen; Post- accident RCS 0-10% volume; Post-accident sump 0-100%	DBA harsh	Auxiliary building	AVI	AVI	AVI	AVI

TABLE B1. (continued)

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
RCS pressure	RCS pressure	0-4000 psig	DBA harsh	Containment and RCS	AVI	FEC	FEC	FEC (T&P)
	PORV flow confirmation							
	Rate of RCS depressurization							
	Relationship to PTS limits							
	Core relocation status							
	Vessel integrity							
	RCS leak integrity							
	Approach to vessel failure							
	RCS boundary failure and fission product release							
	Lower head failure and fission product release							
	RCS pressure greater than ruptured generator							

TABLE B1. (continued)

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
	Containment bypass and fission product release							
	Stabilized RCS conditions (V-sequence isolation)							
	RCS cooldown with steam generators							
Containment isolation valve status	Containment isolation valve position status	Isolation valve position closed-open	DBA harsh	Containment-auxiliary building	AVI	AVI	AVI	FEC
	Containment isolation valves closed							
	Reisolation not possible							
	Closure of isolation valve (V-sequence isolation)							
	Isolation failure and fission product release							
Containment sump inventory	Injection water availability	Narrow range 0-30 in. Wide range 0-120 in. (Containment floor +9 in. - 600,000 gallon level + 4 ft)	Narrow range not qualified DBA harsh	Containment	AVI	AVI	AVI	FEC

TABLE B1. (continued)

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
	Spray water availability							
	RCS boundary failure and fission product release							
	Amount of contaminated water							
RCS coolant temperature	RCS temperature	Cold leg temperature 0-600°F	DBA Harsh	Containment and RCS	AVI	FEC	FEC	FEC
	Relationship to PTS limits	Hot leg temperature 212-705°F						
	RCS overcooling							
	RCS cooldown with intact generator(s)							
	RCS boundary failure and fission product release							
	Lower head failure and fission product release							
	Steam generator secondary system integrity (status)							

TABLE B1. (continued)

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
Cold leg temperature	Core relocation status	0-600 °F	DBA harsh	Containment and RCS	AVI	FEC	FEC	FEC
Steam generator secondary level	Steam generator inventory	Tubesheet to separators -401 in. to +63.5 in. top of steam separators = +39 1/4 in; Tubesheet is at 444 11/16 in. below normal operating level	DBA harsh	Containment	AVI	AVI	AVI	FEC
	Steam generator secondary system integrity (status)							
	Steam generator heat removal capability							
Feedwater tank inventory	Feedwater source availability	Condensate storage tank level, 1 to 38 ft (top)	DBA harsh	Yard	AVI	AVI	AVI	AVI
	Steam generator heat removal capability							
Containment pressure	Containment pressure	-5 to 150 psig	DBA Harsh	Auxiliary building and containment	AVI	AVI	AVI	AVI
	Containment integrity							
	Overpressure control status				Assumes pressure tap in containment does not fail due to containment temperature			
	Penetration of containment by a missile							

TABLE B1. (continued)

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
	Imbalance in energy addition and removal							
	Lower head failure and fission product release							
	Containment bypass and fission product release							
	Basemat integrity							
	Concentration of noncondensables							
	RCS boundary failure and fission product release							
Containment hydrogen concentration	Hydrogen gas concentration	Containment atmosphere hydrogen content 0-10% volume	DBA harsh	Auxiliary building	AVI	AVI	AVI	AVI
	Concentration of noncondensables				Assumes sampling tap does not fail due to containment conditions			

TABLE B2. PLANT-SPECIFIC MEASUREMENTS COMPARED TO REGULATORY GUIDE 1.97--CATEGORY 2

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
Fan cooling system status indicators	Fan and cooling system operation	Containment fan heat removal system 0-2500 gpm	DBA harsh	Auxiliary building	AVI	AVI	AVI	AVI
Fan cooling system heat exchanger differential temperature	Heat exchanger operation and effectiveness	Residual heat removal system flow, same as LPSI flow measurement range 0-2500 gpm/loop 0-8000 gpm total	DBA harsh	Auxiliary building	AVI	AVI	AVI	AVI
Spray water indicators	Spray water availability	Refueling water storage tank wide range 18 in. above bottom to 12 in. below top	DBA non-harsh	Yard	AVI	AVI	AVI	AVI
Spray flow indicators	Spray flow initiation	Containment spray 0-2000 gpm 60%-148% of design flow = 1350 gpm	DBA harsh	Auxiliary building	AVI	AVI	AVI	AVI
Containment atmosphere temperature	Containment atmosphere temperature	Containment dome and reactor cavity temperature 50°F to 300°F	DBA harsh	Containment	AVI	AVI	AVI	FEC
	Containment shell temperature							
	Imbalance in energy addition and removal							
	RCS boundary failure and fission product release							

TABLE B2. (continued)

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
Containment noble gas concentration	Lower head failure and fission product release							
	Noble gas concentration	Common activity range 10^{-7} to 10^5 $\mu\text{Ci/cc}$	DBA non-harsh					
	Concentration of noncondensables							
	Presence of fission product gases in containment atmosphere							
Radiation outside containment	Containment integrity	Site area radiation 0.1 mr/hr to 10 r/hr	Not in harsh environment	Plant site	AVI	AVI	AVI	OOR
	Isolation failure and Fission product release	Main vent effluent monitor 10^{-11} $\mu\text{Ci/cc}$ to 5×10^{-7} $\mu\text{Ci/cc}$ for particulates. Halogens samples analyzed offline.	DBA non-harsh	Auxiliary building	AVI	AVI	AVI	OOR
	Magnitude of fission product release							
	Presence of fission products in steam line	Radiation monitor for vent from SG safety relief valves and atmospheric dump valves 1 r/hr to 10^7 r/hr conver- sion to $\mu\text{Ci/cc}$ available	DBA harsh	Auxiliary building	AVI	AVI	AVI	OOR
	Containment bypass and fission product release							

TABLE B2. (continued)

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
Injection pump flow rate HPCI/LPSI/CP/ Boric acid charging flow	Injection pump flow	HPSI 0-300 gpm/loop	DBA harsh	Auxiliary building	AVI	AVI	AVI	AVI
		LPSI 0-2500 gpm/loop	DBA harsh	Auxiliary building	AVI	AVI	AVI	AVI
		0-8000 gpm total flow	DBA harsh	Auxiliary building	AVI	AVI	AVI	AVI
		CP 0-140 gpm	DBA harsh	Auxiliary building	AVI	AVI	AVI	AVI
	Flow of water to damaged core	Boric acid makeup pumps 0-140 gpm	DBA non-harsh	Auxiliary building	AVI	AVI	AVI	AVI
Steam generator secondary pressure	Steam generator secondary pressure	0-1200 psia	DBA harsh	Containment	AVI	AVI	AVI	FEC
	Steam generator removal capability							
	RCS pressure greater than ruptured generator							
	RCS cooldown with steam generator(s)							
RCS injection water tanks inventories	Injection water availability	Volume control tank 0-120 in. 0-100%	Non-DBA harsh	Auxiliary building	AVI	AVI	AVI	AVI
	Injection water inventory	Refueling water storage tank wide range 18 in. above bottom to 12 in. below top	DBA Not in harsh environment	Yard	AVI	AVI	AVI	AVI

TABLE B2. (continued)

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
	RCS leak integrity (status)	Safety injection tanks 0-333 in. 5-95% Boric acid storage tanks 0-100%	Non-DBA harsh DBA non-harsh	Containment Auxiliary building	AVI AVI	FEC AVI	FEC AVI	FEC AVI
RCS subcooling margin	RCS boundary failure and fission product release	Subcooling monitor hot cold leg temp. range 212-705°F RCS Pressure range 15-3208 psia	DBA harsh	Containment and RCS	AVI	FEC	FEC	FEC
	Containment bypass and fission product release	subcooled margin 0-100°F subcooling						
	Stabilized RCS conditions (V-sequence isolation)							
Main steam line radiation level	Presence of fission products in steam line	See radiation monitor for safety SG relief valves and atmospheric dump valves						
Condenser off gas radiation level	Presence of fission products in steam line	Effluent radioactivity Noble gas from						
Steam flow rate	RCS cooldown with intact generator(s)	condensor air removal exhaust 10^{-7} to 10^{-2} $\mu\text{Ci/cc}$	DBA harsh	Turbine building	AVI	AVI	AVI	AVI
Containment circulation system status	Containment circulation system operating	See containment heat removal by containment fan heat removal system						
	Initiation of chemical reactions strategy							

TABLE B2. (continued)

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
Status of containment heat removal systems	Operation of containment heat removal systems	See containment fan heat removal system containment spray flow	Fans and spray flow		AVI	AVI	AVI	AVI
PORV flow	PORV flow confirmation	Primary system relief valves and power operated relief valves closed-not closed acoustic monitors downstream of SRV & PORV 1%-100% flow	DBA harsh	Containment	AVI	AVI	AVI	FEC
Auxiliary feedwater flow rate	Flow to steam generator	Main feed flow 0-6 x 10 ⁶ lb/hr	Non DBA harsh	Turbine building	AVI	AVI	AVI	AVI
		Auxiliary feed flow 0-500 gpm (motor driven) 0-750 gpm (steam driven)	DBA harsh	Auxiliary building	AVI	AVI	AVI	AVI
Sump water temperature	Sump water temperature			Plant determined no instrument required				
	Inadequate heat removal from sump water							
	Release of fission products from sump water							

TABLE B2. (continued)

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
Sump water cooling heat exchanger outlet temperature	Inadequate heat removal from sump water	Residual heat removal outlet temperature 0-650°F	DBA harsh	Auxiliary building	AVI	AVI	AVI	AVI
	Trend in sump water temperature	Residual system flow/ decay heat removal flow uses LPSI pump 0-2500 gpm/pump 0-8000 gpm total flow	DBA harsh	Auxiliary building	AVI	AVI	AVI	AVI
Status of containment	Operation of containment	See containment fan containment spray flow 0-2000 gpm						
Status of sump water cooling system	Operation of sump water cooling system	60-148% design Design flow = 1350 gpm	DBA harsh	Auxiliary building	AVI	AVI	AVI	AVI

TABLE B3. PLANT-SPECIFIC MEASUREMENTS COMPARED TO REGULATORY GUIDE 1.97--CATEGORY 3

Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
Feedwater flow rate	Flow to steam generator	0-6 x 10 ⁶ lb/hr	Non-DBA non-harsh	Turbine building	FSS	FSS	FSS	FSS
	Feedwater flow initiation							
Quench tank inventory	Quench tank level	QT level 6-48 in. 4%-96%	Non DBA harsh	Containment	FSS	FSS	FSS	FSS
	Quench tank level above relief valve discharge level	QT pressure 0-100 psig QT temperature 50-350°F						
	PORV flow confirmation							
	Transport of fission products through relief valve							
	Relief valve flow status							
Containment radiation level (and location)	Presence of radiation in containment	Containment area radiation high range 1 to 10 ⁸ r/hr for energy range 0.1 to 3 MeV	Non-DBA harsh	Containment	FSS	FSS	FSS	FSS
	Containment radiation level	Common plant vent-noble gas vent flow rate noble gas activity range 10 ⁻⁷ to 10 ⁵ μ Ci/cc	Non DBA harsh	Auxiliary building	FSS	FSS	FSS	FSS
	Quantity of fission products being dispersed from RCS and location	Activity plus flow displayed Activity recorded on trend recorders						

TABLE B3. (continued)

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
Containment radiation level (and location) (cont'd)	Presence of fission products in containment atmosphere							
	Presence of fission products in quench tank							
	Presence of fission product gases in containment atmosphere							
	Presence of fission products in relief valve discharge flow							
	RCS boundary failure and fission product release							
	Lower head failure and fission product release							
	Presence of aerosols in containment atmosphere							
	Presence of fission products in containment water							

TABLE B3. (continued)

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
Sump water radiation level	Presence of fission products in containment water	See primary and sump gross activity						
Quench tank water temperature	Quench tank temperature	Quench tank temp 50-350°F	Non-DBA harsh	Containment	FSS	FSS	FSS	FSS
	Quench tank cooling	Quench tank level 0-48 in. alarm = 55% 26.4 in.						
	Relief valve flow status	See safety relief valve position/flow above						
	Transport of fission products through relief valve							
Quench tank pressure	Quench tank pressure	0-100 psig, rupture disc pressure = 100 psig	Non-DBA harsh	Containment	FSS	FSS	FSS	FSS
	Relief valve flow status							
	Transport of fission products through relief valve							

TABLE B3. (continued)

Potential Measurements Identified	Information Need	Current Measurement Range	Current Qualification Information	Location of Sensor	Status in Phase			
					1	2	3	4
Containment sump water chemistry	Containment water pH	Primary coolant and sump pH 3-12	Non-DBA harsh	Auxiliary building	FSS	FSS	FSS	FSS
	Presence of iodine							
	Presence of fission products in containment water	See primary coolant and sump gross activity						
Reactor coolant flow	Reactor coolant pump status	Pump motor current 0-400 amps	Non-DBA Non-harsh	Auxiliary building	FSS	FSS	FSS	FSS

APPENDIX C

**EXISTING MEASUREMENTS NOT
SPECIFIED IN REGULATORY GUIDE 1.97**

APPENDIX C

EXISTING MEASUREMENTS NOT SPECIFIED IN REGULATORY GUIDE 1.97

The tables contained in Appendix C list those existing measurements that could be used for accident management that are not specified in Regulatory Guide 1.97. This table includes columns to list the

current measurement range of the instrument, the severe accident measurement range, and the location of the sensor.

TABLE C. EXISTING MEASUREMENTS NOT SPECIFIED IN REGULATORY GUIDE 1.97

Existing Measurements Identified	Information Need	Current Measurement Range	Potential Severe Accident Measurement Range	Location of Sensor
Core Temperature (SPNDS)	Core Temperature	Current	Same	Reactor
Containment	Containment Humidity	Containment Dome and Reactor Cavity 0 to 100%	Same	Containment and Containment Cavity
	RCS Boundary and Fission Product Release			
	Lower Head Failure and Fission Product Release			
Air and Nitrogen Equipment Status	Concentration of Noncondensables (Air and Nitrogen Leak Status)			
Recombiner/ Igniters Equip- ment Status	Initiation of Recombiners/Igniters			
Auxiliary Spray Flow	Auxiliary Spray Flow Initiation	Pressurizer Auxiliary Spray Temperature 0-600°F	Same	Auxiliary Building

TABLE C. (continued)

<u>Potential Measurements Identified</u>	<u>Information Need</u>	<u>Current Measurement Range</u>	<u>Potential Severe Accident Measurement Range</u>	<u>Location of Sensor</u>
Auxiliary, main, and alternate feedwater system status	Steam generator heat removal capability	Main-pump suction flow 0-2000 GPM, pump suction pressure 0-500 psig, steam and feed flow 0-6x10 ⁶ lbs/hr, pump bearing temperature, pump discharge pressure 0-2000 psig, vibration monitor; auxiliary-discharge pressure 0-2000 psig, turbine steam pressure 0-1200 psig, pump motor current 0-100 amps; CST level 0-38 ft.	Same	Turbine building
			Same	Auxiliary building

APPENDIX D

**INFORMATION-NEEDS TABLES FOR A SPECIFIC
PWR AND SEVERE ACCIDENT SEQUENCE**

APPENDIX D

INFORMATION-NEEDS TABLES FOR A SPECIFIC PWR AND SEVERE ACCIDENT SEQUENCE

The tables contained in Appendix D present information needs for a specific PWR and for specific severe accident conditions. The instrument availability was determined using the tables in Appendix B and transposed to Tables D1, D2, and D3 of Appendix D to identify the status of the information needs for each of the safety objective trees. Information need status is indicated by the following acronyms:

- ADI – available directly or indirectly

- ADO – available directly only
- AIO – available indirectly only
- NAV – not available.

The status of the information needs is indicated in brackets in the Information Needs column in Tables D1, D2, and D3.

TABLE D1.1. PREVENT CORE DISPERSAL FROM VESSEL (V)--INADEQUATE INVENTORY MECHANISM (V1A1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain RCS Heat Removal Safety Function (V1)	Energy removal rate [AIO AIO AIO NAV]	None		None					
			RCS fluid temperature	Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
			RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC
			Steam generator steam flow	Steam flow indicators		FEC	FEC	FEC	FEC
			PORV discharge pipe noise	Acoustic monitor		AVI	AVI	AVI	FEC
			RHR heat removal	RHR flows, temperatures		FEC	FEC	FEC	FEC
	<u>Indicator</u>								
Inadequate Secondary Inventory Mechanism (V1A1)	Secondary fluid inventory [ADO ADO ADO NAV]	Secondary liquid level		Secondary liquid level		AVI	AVI	AVI	FEC

TABLE D1.1. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
D-5	<u>Precursor</u>								
	Feedwater flow status [ADO ADO ADO ADO]	Feedwater flow rate		Feedwater flow rate (MFW flow AFW flow)		FSS AVI	FSS AVI	FSS AVI	FSS AVI
	<u>Selection Criteria</u>								
	Injection Methods Strategy	Inventory availability [ADO ADO ADO ADO]	Tank inventories	Tank levels		FEC	FEC	FEC	FEC
		Pumping capability [ADO ADO ADO ADO]	Electrical power availability			AVI	AVI	AVI	AVI
			Steam availability			AVI	AVI	AVI	AVI
		Alignment capability [ADO ADO ADO ADO]	Valve alignments	Valve position indicators		AVI	AVI	AVI	AVI
	<u>Strategy Initiation</u>								
	Feedwater flow status [ADO ADO ADO ADO]	Feedwater flow rate		Feedwater flow rate (MFW flow AFW flow)		FSS AVI	FSS AVI	FSS AVI	FSS AVI

TABLE D1.1. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>				
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	
<u>Strategy Initiation (continued)</u>									
Injection water inventory (decreasing) [ADO ADO ADO ADO]	Tank inventory		Tank level SI Tanks RWST		FEC AVI	FEC AVI	FEC AVI	FEC AVI	
<u>Strategy Effectiveness</u>									
RCS fluid temperature [ADO NAV NAV NAV]	RCS fluid temperature		Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC	
Secondary fluid inventory [ADO ADO ADO NAV]	Secondary liquid level		Secondary liquid level		AVI	AVI	AVI	FEC	
<u>Selection Criteria</u>									
Inventory Sources Strategy	Inventory availability [ADO ADO ADO ADO]	Tank inventories	Tank level (SIT, RWST)		FEC AVI	FEC AVI	FEC AVI	FEC AVI	
	Pumping capability [ADO ADO ADO ADO]	Electric power availability			AVI	AVI	AVI	AVI	
		Steam availability			AVI	AVI	AVI	AVI	

TABLE D1.1. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria (continued)</u>								
Alignment capability [ADO ADO ADO ADO]	Valve alignments		Valve position indicators		AVI	AVI	AVI	AVI
<u>Strategy Initiation</u>								
Injection water inventory (decreasing) [ADO ADO ADO ADO]	Tank inventory		Tank level (SIT, RWST)		FEC AVI	FEC AVI	FEC AVI	FEC AVI
Feedwater flow status [ADO ADO ADO ADO]	Feedwater flow rate		Feedwater flow rate (MFW flow AFW flow)		FSS AVI	FSS AVI	FSS AVI	FSS AVI
<u>Strategy Effectiveness</u>								
RCS fluid temperature [ADO NAV NAV NAV]	RCS fluid temperature		Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
Secondary fluid inventory [ADO ADO ADO NAV]	Secondary liquid level		Secondary liquid level		AVI	AVI	AVI	FEC

TABLE D1.2. PREVENT CORE DISPERSAL FROM VESSEL (V)--INADEQUATE PRESSURE CONTROL MECHANISM (V1A2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain RCS Heat Removal Safety Function (V1)	Energy removal rate [AIO NAV NAV NAV]	None		None					
			RCS fluid temperature	Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
			RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC
			Steam generator steam flow	Steam flow indicators		FEC	FEC	FEC	FEC
			PORV directory pipe noise	Acoustic monitors		AVI	AVI	AVI	FEC
			RHR heat removal	RHR flows, temperatures		AVI	FEC	FEC	FEC
	<u>Indicator</u>								
Inadequate Pressure Control Mechanism (V1A2)	RCS - Steam Generator Pressure difference [AIO NAV NAV NAV]	Steam generator secondary pressure		Steam generator secondary pressure		AVI	AVI	AVI	FEC
		RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC

TABLE D1.2. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Precursor</u>								
	Secondary ADV flow rate [AIO AIO AIO AIO]	ADV flow indicator	ADV valve position	None		AVI	AVI	AVI	AVI
	Steam dump flow rate [AIO AIO AIO AIO]	None	Steam dump valve position	Steam dump valve position indicator		AVI	AVI	AVI	AVI
	Turbine bypass flow rate [NAV NAV NAV NAV]	Turbine bypass flow indicator		Turbine bypass flow indicator		FSS	FSS	FSS	FSS
	<u>Selection Criteria</u>								
Open Secondary ADV Strategy	RCS - Steam generator pressure difference [AIO NAV NAV NAV]	Steam generator secondary pressure		Steam generator secondary pressure		AVI	AVI	AVI	FEC
		RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	ADV status [ADO ADO ADO ADO]	Electric power/air availability				AVI	AVI	AVI	AVI

TABLE D1.2. (continued)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
<u>Information Needs</u>						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Initiation</u>									
	Secondary ADV flow rate [AIO AIO AIO AIO]	ADV flow indicator	ADV valve position	ADV valve position indicator		AVI	AVI	AVI	AVI
<u>Strategy Effectiveness</u>									
	RCS fluid temperature [ADO NAV NAV NAV]	RCS fluid temperature		Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
<u>Selection Criteria</u>									
Open Atmospheric Dump Valves Strategy	RCS - Steam generator pressure difference [ADO NAV NAV NAV]	Steam generator secondary pressure		Steam generator secondary pressure		AVI	AVI	AVI	FEC
		RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	Atmospheric dump valve status [AID AID AID AID]	Electric power/air availability				AVI	AVI	AVI	AVI

TABLE D1.2. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Strategy Initiation</u>								
	Atmospheric dump valve flow rate [AID AID AID AID]	Atmospheric dump valve flow indicator	None	Atmospheric dump valve position		AVI	AVI	AVI	AVI
	<u>Strategy Effectiveness</u>								
	RCS fluid temperature [ADO NAV NAV NAV]	RCS fluid temperature		Hot or Cold leg RTDs, CETs		AVI	FEC	FEC	FEC
	<u>Selection Criteria</u>								
Open Turbine Bypass Valves Strategy	RCS - Steam generator pressure difference [ADO NAV NAV NAV]	Steam generator secondary pressure		Steam generator secondary pressure		AVI	AVI	AVI	FEC
		RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	Turbine bypass valve status [NAV NAV NAV NAV]	Electric power/air availability				FSS	FSS	FSS	FSS

TABLE D1.2. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Initiation</u>								
Turbine bypass valve flow rate [NAV NAV NAV NAV]	Turbine bypass valve flow indicator		Turbine bypass valve flow indicator		FSS	FSS	FSS	FSS
<u>Strategy Effectiveness</u>								
RCS fluid temperature [AIO NAV NAV NAV]	RCS fluid temperature		Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC

TABLE D1.3. PREVENT CORE DISPERSAL FROM VESSEL (V)--INADEQUATE RCS ENERGY TRANSPORT MECHANISM (V1A3)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain RCS Heat Safety Function (V1)	Energy removal rate [AIO NAV NAV NAV]	None		None					
			RCS fluid temperature	Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
			RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC
			Steam generator steam flow	Steam flow indicators		FEC	FEC	FEC	FEC
			PORV flow	PORV flow indicators					
			RHR heat removal	RHR flows, temperatures		FEC	FEC	FEC	FEC
	<u>Indicator</u>								
Inadequate RCS Energy Transport Mechanism (V1A3)	RCS energy Transport [AIO NAV NAV NAV]	None		None					
			RCS flow rate	RCS flow rate		FEC	FEC	FEC	FEC
			RCS fluid temperature	Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
			RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC

TABLE D1.3. (continued)

						<u>Status in Phase</u>							
<u>Information Needs</u>						<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Precursor</u>													
RCS Inventory (low) [AIO NAV NAV NAV]	Vessel inventory					Vessel inventory	RVLMS		AVI	FEC	FEC	FEC	
						Pressurizer inventory	Pressurizer level		AVI	FEC	FEC	FEC	
						Reactor vessel inventory	RVLMS						
<u>Selection Criteria</u>													
RCS Pump Restart Strategy	RCS flow rate [NAV NAV NAV NAV]					RCS flow rate		RCS flow rate		FEC	FEC	FEC	FEC
	RCS pump status [NAV NAV NAV NAV]					RCS pump speed		RCS pump speed		FEC	FEC	FEC	FEC
	RCS pressure [ADO NAV NAV NAV]					RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	Steam generator secondary status [ADO ADO ADO NAV]					Steam generator secondary pressure		Steam generator secondary pressure		AVI	AVI	AVI	FEC
						Steam generator secondary inventory		Steam generator level		AVI	AVI	AVI	FEC

TABLE D1.3. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Strategy Initiation</u>								
	RCS pump speed [NAV NAV NAV NAV]	RCS pump speed		RCS pump speed		FEC	FEC	FEC	FEC
	RCS flow rate [NAV NAV NAV NAV]	RCS flow rate		RCS flow rate		FEC	FEC	FEC	FEC
	<u>Strategy Effectiveness</u>								
	RCS fluid temperature [ADO NAV NAV NAV]	RCS fluid temperature		Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
	RCS pressure [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	<u>Selection Criteria</u>								
Injection Methods Strategy	Inventory availability [ADO ADO ADO ADO]	Tank inventories		Tank levels (SIT, RWST)		FEC	FEC	FEC	FEC
	Pumping capability [ADO ADO ADO ADO]	Electrical power availability				AVI	AVI	AVI	AVI
		Steam availability				AVI	AVI	AVI	AVI

TABLE D1.3. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria (continued)</u>								
Alignment capability [ADO ADO ADO ADO]	Valve alignments		Valve position indicators		AVI	AVI	AVI	AVI
<u>Strategy Initiation</u>								
Feedwater flow status [ADO ADO ADO ADO]	Feedwater flow rate		Feedwater flow rate (MFW flow AFW flow)		FSS AVI	FSS AVI	FSS AVI	FSS AVI
Injection water inventory (decreasing) [ADO ADO ADO ADO]	Tank inventory		Tank level SI Tanks RWST		FEC AVI	FEC AVI	FEC AVI	FEC AVI
<u>Strategy Effectiveness</u>								
RCS fluid temperature [ADO NAV NAV NAV]	RCS fluid temperature		Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
Secondary fluid inventory [ADO ADO ADO NAV]	Secondary liquid level		Secondary liquid level		AVI	AVI	AVI	FEC

TABLE D1.3. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Selection Criteria</u>								
Inventory Sources Strategy	Inventory availability [ADO ADO ADO ADO]	Tank inventories		Tank level (SIT, RWST)		FEC AVI	FEC AVI	FEC AVI	FEC AVI
	Pumping capability [ADO ADO ADO ADO]	Electric power availability				AVI	AVI	AVI	AVI
		Steam availability				AVI	AVI	AVI	AVI
	Alignment capability [ADO ADO ADO ADO]	Valve alignments		Valve position indicators		AVI	AVI	AVI	AVI
	<u>Strategy Initiation</u>								
	Injection water inventory (decreasing) [ADO ADO ADO ADO]	Tank inventory		Tank level (SIT, RWST)		FEC AVI	FEC AVI	FEC AVI	FEC AVI
	Feedwater flow status [ADO ADO ADO ADO]	Feedwater flow rate		Feedwater flow rate (MFW flow AFW flow)		FSS AVI	FSS AVI	FSS AVI	FSS AVI

TABLE D1.3. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Effectiveness</u>								
RCS fluid temperature [ADO NAV NAV NAV]	RCS fluid temperature		Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
Secondary fluid inventory [ADO ADO ADO NAV]	Secondary liquid level		Secondary liquid level		AVI	AVI	AVI	FEC

TABLE D1.4. PREVENT CORE DISPERSAL FROM VESSEL (V)--RESTRICTED RCS BLEED MECHANISM (V1B1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain RCS Heat Removal Safety Function (V1)	Energy removal rate [AIO AIO AIO NAV]	None		None					
			RCS fluid temperature	Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
			RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC
			Steam generator steam flow	Steam flow indicators		FEC	FEC	FEC	FEC
			PORV discharge pipe noise	Acoustic monitors		AVI	AVI	AVI	FEC
			RHR heat removal	RHR flows, temperatures		FEC	FEC	FEC	FEC
	<u>Indicator</u>								
Restricted RCS Bleed Mechanism (V1B1)	RCS PORV flow rate [AIO AIO AIO NAV]	None		None					
			RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC
			PORV discharge pipe temperature	PORV discharge pipe temperature		AVI	AVI	AVI	FEC

TABLE D1.4. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Indicator (continued)</u>								
			PORV discharge pipe noise	Acoustic monitors		AVI	AVI	AVI	FEC
			Quench tank inventory	Quench tank level		FSS	FSS	FSS	FSS
	<u>Precursor</u>								
	None [NAV NAV NAV NAV]	None		None					
	<u>Selection Criteria</u>								
Power to PORV Strategy	RCS pressure (high)	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	[ADO NAV NAV NAV] RCS inventory (decreasing)	None		None					
	[AIO NAV NAV NAV]		Pressurizer inventory	Pressurizer level		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC

TABLE D1.4. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Initiation</u>								
PORV flow (confirmation)	None		None	PORV flow sensor				
[AIO AIO AIO NAV]		RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC
		PORV discharge pipe temperature	PORV discharge pipe temperature		AVI	AVI	AVI	FEC
		PORV discharge pipe noise	Acoustic monitors		AVI	AVI	AVI	FEC
		Quench tank inventory	Quench tank level		FSS	FSS	FSS	FSS
<u>Strategy Effectiveness</u>								
RCS pressure history [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
RCS temperature history [ADO NAV NAV NAV]	RCS coolant temperature		Subcooled margin monitor		AVI	FEC	FEC	FEC
			Cold and hot leg RTDs, CETs		AVI	FEC	FEC	FEC

TABLE D1.4. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Selection Criteria</u>								
Alternate Systems Strategy	RCS pressure (high)	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	[ADO NAV NAV NAV] RCS inventory (decreasing)	None		None					
	[AIO NAV NAV NAV]		Pressurizer inventory	Pressurizer level		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
	<u>Strategy Initiation</u>								
	Hardware dependent			Hardware dependent					
	<u>Strategy Effectiveness</u>								
	RCS pressure history [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	RCS temperature history [ADO NAV NAV NAV]	RCS coolant temperature		Subcooled margin monitor		AVI	FEC	FEC	FEC
				Cold and hot leg RTDs, CETs		AVI	FEC	FEC	FEC

TABLE D1.5. PREVENT CORE DISPERSAL FROM VESSEL (V)--RHR SYSTEMS INOPERABLE (V1B2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Selection Criteria</u>								
Maintain RCS Heat Removal Safety Function (V1)	Energy removal rate [AIO AIO AIO NAV]	None		None					
			RCS fluid temperature	Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
			RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC
			Steam generator steam flow	Steam flow indicators		FEC	FEC	FEC	FEC
			PORV discharge pipe noise	Acoustic monitors		AVI	AVI	AVI	FEC
			RHR heat removal	RHR flows, temperatures		FEC	FEC	FEC	FEC
	<u>Indicator</u>								
RHR Systems Inoperable Mechanism (V1B2)	RHR energy removal rate	Heat exchanger differential temperature		Heat exchanger inlet and outlet fluid temperatures		AVI	FEC	FEC	FEC
	[ADO NAV NAV NAV]	RHR system flow rate		RHR system flow rate		AVI	FEC	FEC	FEC

TABLE D1.5. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
D-24	<u>Precursor</u>								
	RCS temperature [ADO NAV NAV NAV]	RCS temperature		Hot and cold leg RTDs, CETs		AVI	FEC	FEC	FEC
	RCS pressure [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	<u>Selection Criteria</u>								
	RHR Flow Restoration Strategy	RHR system flow rate [ADO NAV NAV NAV]	RHR system flow rate	RHR system flow rate		AVI	FEC	FEC	FEC
		RCS pressure [ADO NAV NAV NAV]	RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC
		RCS temperature	RCS temperature	Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
	<u>Strategy Initiation</u>								
	RHR system flow rate [ADO NAV NAV NAV]	RHR system flow rate		RHR system flow rate		AVI	FEC	FEC	FEC

TABLE D1.5. (continued)

		Direct	Indirect			Status in Phase			
<u>Information Needs</u>		<u>Information</u>	<u>Information</u>	<u>Available</u>	<u>Potential</u>				
		<u>Source</u>	<u>Source</u>	<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Effectiveness</u>									
	RCS temperature [ADO NAV NAV NAV]	RCS temperature		Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
	RCS pressure [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
<u>Selection Criteria</u>									
Alternate Heat Sinks Strategy	RHR system flow rate [ADO NAV NAV NAV]	RHR system flow rate		RHR system flow rate		AVI	FEC	FEC	FEC
	RHR heat exchanger flow rate [ADO NAV NAV NAV]	RHR heat exchanger flow rate		RHR heat exchanger flow rate		AVI	FEC	FEC	FEC
	RCS pressure [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	RCS temperature [ADO NAV NAV NAV]	RCS temperature		Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC

TABLE D1.5. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Initiation</u>								
RHR heat exchanger flow rate [ADO NAV NAV NAV]	RHR heat exchanger flow rate		RHR heat exchanger flow rate		AVI	FEC	FEC	FEC
RHR system flow rate [ADO NAV NAV NAV]	RHR system flow rate		RHR system flow rate		AVI	FEC	FEC	FEC
<u>Strategy Effectiveness</u>								
RCS temperature [ADO NAV NAV NAV]	RCS temperature		Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
RCS pressure [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC

TABLE D1.6. PREVENT CORE DISPERSAL FROM VESSEL (V)--SCRAM FAILURE MECHANISM (V2A1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Selection Criteria</u>								
Maintain Core Heat Removal Safety Function	Core heat removal rate [AIO AIO AIO AIO]	None		None					
			Fuel rod temperature	None					
			Core exit temperature history	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity level	RCS sampling system		AVI	AVI	AVI	AVI
	<u>Indicator</u>								
Scram Failure Mechanism	Energy generation rate [NAV NAV NAV NAV]	Neutron detection		Power, intermediate, source range monitors		FEC	FEC	FEC	FEC
	Control Rod positions [NAV NAV NAV NAV]	Rod position indicator		Rod position indicator		FEC	FEC	FEC	FEC
		Rod bottom indicator		Rod bottom indicator		FEC	FEC	FEC	FEC

TABLE D1.6. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Indicator (continued)</u>								
			Self powered neutron detectors		AVI	FEC	FEC	FEC
Borated water injection rate [ADI ADI ADI ADI]	Injection flow rates		HPIS, LPIS charging system flow rates		AVI	AVI	AVI	AVI
		Borated water storage tank inventory	Tank levels		AVI	AVI	AVI	AVI
<u>Precursor</u>								
None								
<u>Selection Criteria</u>								
Control Rod Insertion Strategies	Control Rod position [NAV NAV NAV NAV]	Rod position indicator		Rod position indicator	FEC	FEC	FEC	FEC
	Energy generation rate [NAV NAV NAV NAV]	Neutron detection		Power, intermediate, source range monitors	FEC	FEC	FEC	FEC

TABLE D1.6. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Strategy Initiation</u>								
	Control rod position indicator	Control rod position indicator		Control rod position indicator		FEC	FEC	FEC	FEC
	[NAV NAV NAV NAV]	Rod bottom indicator		Rod bottom indicator		FEC	FEC	FEC	FEC
	<u>Strategy Effectiveness</u>								
	Energy generation rate [NAV NAV NAV NAV]	Neutron detection		Power, intermediate, source range monitors		FEC	FEC	FEC	FEC
	<u>Selection Criteria</u>								
Injection Methods Strategies	Alignment capabilities [ ]	Valve alignments		Valve position indicators					
	Pumping capabilities [ ]	Electrical power availability							
	Borated water inventory availability [ADO ADO ADO ADO]	Tank inventories		Tank levels		AVI	AVI	AVI	AVI

TABLE D1.6. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Strategy Initiation</u>								
	RCS injection status [ADO ADO ADO ADO]	RCS injection flow rate		RCS injection discharge flow rate and pressure		AVI	AVI	AVI	AVI
	Injection water inventory (decreasing) [ADO ADO ADO ADO]	Tank inventory		Tank level (SIT, RWST)		AVI FEC	AVI FEC	AVI FEC	AVI FEC
	<u>Strategy Effectiveness</u>								
	Energy generator rate [ADO NAV NAV NAV]	Neutron detection		Power, intermediate, source range monitors		FEC	FEC	FEC	FEC
				Self-powered neutron detectors		AVI	FEC	FEC	FEC
	<u>Selection Criteria</u>								
Boration Methods Strategies	Energy generation rate [NAV NAV NAV NAV]	Neutron detection		Power, intermediate, source range monitors		FEC	FEC	FEC	FEC

TABLE D1.6. (continued)

<u>Information Needs</u>	Direct	Indirect	<u>Available</u>	<u>Potential</u>	<u>Status in Phase</u>				
	<u>Information</u>	<u>Information</u>			<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>	<u>3</u>
	<u>Source</u>	<u>Source</u>							
<u>Selection Criteria (continued)</u>									
Borated water availability [ADO ADO ADO ADO]	Tank inventories		Tank levels		AVI	AVI	AVI	AVI	
Injection system capabilities [ ]	Injection system status								
<u>Strategy Initiation</u>									
RCS injection status [ADO ADO ADO ADO]	RCS injection flow rate		RCS injection discharge flow rate and pressure		AVI	AVI	AVI	AVI	
<u>Strategy Effectiveness</u>									
Energy generator rate [ADO NAV NAV NAV]	Neutron detection		Power, intermediate, source range monitors		FEC	FEC	FEC	FEC	
			Self-powered neutron detectors		AVI	FEC	FEC	FEC	

TABLE D1.7. PREVENT CORE DISPERSAL FROM VESSEL (V)--RECRITICALITY (V2A2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Selection Criteria</u>								
Maintain Core Heat Removal Safety Function	Core heat removal [AIO NAV NAV NAV]	None		None					
			Fuel rod temperature	None					
			Core exit temperature history	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity level	RCS sampling system		AVI	AVI	AVI	AVI
	<u>Indicator</u>								
Recriticality Mechanism (V2A2)	Energy generation rate [ADO NAV NAV NAV]	Neutron detector		Power, intermediate, source range monitors		FEC	FEC	FEC	FEC
				Self-powered neutron detectors		AVI	FEC	FEC	FEC

TABLE D1.7. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Precursor</u>								
	RCS fluid temperature (low) [ADO NAV NAV NAV]	RCS fluid temperature		Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
	Location of control rod material [ADO NAV NAV NAV]	None		None					
			Core exit temperature	Core exit thermocouple		AVI	FEC	FEC	FEC
	<u>Selection Criteria</u>								
Injection Methods Strategies	Alignment capabilities	Valve alignments		Valve position indicators					
	Pumping capabilities	Electrical power availability							
	Borated water inventory availability [ADO ADO ADO ADO]	Tank inventories		Tank levels		AVI	AVI	AVI	AVI

TABLE D1.7. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Strategy Initiation</u>								
	RCS injection status [ADO ADO ADO ADO]	RCS injection flow rate		RCS injection discharge flow rate and pressure		AVI	AVI	AVI	AVI
	Injection water inventory (decreasing) [ADO ADO ADO ADO]	Tank inventory		Tank level (SIT, RWST)		AVI FEC	AVI FEC	AVI FEC	AVI FEC
	<u>Strategy Effectiveness</u>								
	Energy generator rate [ADO NAV NAV NAV]	Neutron detection		Power, intermediate, source range monitors		FEC	FEC	FEC	FEC
				Self-powered neutron detectors		AVI	FEC	FEC	FEC
	<u>Selection Criteria</u>								
Boration Methods Strategies	Energy generation rate [NAV NAV NAV NAV]	Neutron detection		Power, intermediate, source range monitors		FEC	FEC	FEC	FEC

TABLE D1.7. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria (continued)</u>								
Borated water availability [ADO ADO ADO ADO]	Tank inventories		Tank levels		AVI	AVI	AVI	AVI
Injection system capabilities	Injection system status							
<u>Strategy Initiation</u>								
RCS injection status [ADO ADO ADO ADO]	RCS injection flow rate		RCS injection discharge flow rate and pressure		AVI	AVI	AVI	AVI
<u>Strategy Effectiveness</u>								
Energy generator rate [ADO NAV NAV NAV]	Neutron detection		Power, intermediate, source range monitors		FEC	FEC	FEC	FEC
			Self-powered neutron detectors		AVI	FEC	FEC	FEC

TABLE D1.8. PREVENT CORE DISPERSAL FROM VESSEL (V)--CIRCULATION FAILURE MECHANISM (V2A3)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Selection Criteria</u>								
Maintain Core Heat Removal Safety Function	Core heat removal	None		None					
	[AIO NAV NAV NAV]		Fuel rod temperature	None					
			Core exit temperature history	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity level	RCS sampling system		AVI	AVI	AVI	AVI
	<u>Indicator</u>								
Circulation Failure Mechanism (V2A3)	RCS flow status	RCS flow rate		RCS flow rate		FEC	FEC	FEC	FEC
	[NAV NAV NAV NAV]	RCS pump speed		RCS pump speed		FEC	FEC	FEC	FEC
		RCS pump differential pressure		RCS pump differential pressure		FEC	FEC	FEC	FEC

TABLE D1.8. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Indicator (continued)</u>								
	Fuel rod cladding temperature (high) AIO NAV NAV NAV]	None	Core exit temperature	None Core exit thermocouple		AVI	FEC	FEC	FEC
	<u>Precursor</u>								
	RCS pump status [ADO NAV NAV NAV]	Bearing temperature Lube oil pressure Electrical power		Bearing thermocouple Lube oil pump differential pressure		AVI	FEC	FEC	FEC
	<u>Selection Criteria</u>								
RCS Pump Restart Strategy	RCS flow status [NAV ANV NAV NAV]	RCS flow rate RCS pump speed RCS pump differential pressure		RCS flow rate RCS pump speed RCS pump differential pressure		FEC	FEC	FEC	FEC
						FEC	FEC	FEC	FEC
						FEC	FEC	FEC	FEC

TABLE D1.8. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria (continued)</u>								
Fuel rod cladding temperature [AIO NAV NAV NAV]	None		None					
		Core exit temperature	Core exit thermocouple		AVI	FEC	FEC	FEC
<u>Strategy Initiation</u>								
RCS flow status [NAV NAV NAV NAV]	RCS flow rate		RCS flow rate		FEC	FEC	FEC	FEC
<u>Strategy Effectiveness</u>								
RCS flow status [NAV NAV NAV NAV]	RCS flow rate		RCS flow rate		FEC	FEC	FEC	FEC
Fuel rod cladding temperature [AIO NAV NAV NAV]	None		None					
		Core exit temperature	Core exit thermocouple		AVI	FEC	FEC	FEC

TABLE D1.9. PREVENT CORE DISPERSAL FROM VESSEL (V)--INADEQUATE RCS INVENTORY (V2A4)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Selection Criteria</u>								
Maintain Core Heat Removal Safety Function	Core heat removal	None		None					
	[AID NAV NAV NAV]		Fuel rod temperature	None					
			Core exit temperature history	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity level	RCS sampling system		AVI	AVI	AVI	AVI
	<u>Indicator</u>								
Inadequate RCS Inventory Mechanism (V2A4)	RCS inventory status	None		None					
	[AIO NAV NAV NAV]		Pressurizer inventory	Pressurizer level		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			Core exit temperature	Core exit thermocouple		AVI	FEC	FEC	FEC

TABLE D1.9. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Indicator (Continued)</u>								
	Containment sump inventory (increasing) [ADO ADO ADO NAV]	Containment sump level		Containment sump level		AVI	AVI	AVI	FEC
	<u>Precursor</u>								
	RCS pressure (low) [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	Injection flow rate [ADO ADO ADO ADO]	Injection flow rate		Injection flow rate		AVI	AVI	AVI	AVI
	<u>Selection Criteria</u>								
RCS Injection Methods Strategies	RCS pressure history [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	RCS inventory (trend) [AIO NAV NAV NAV]	None		None					
			Pressurizer inventory	Pressurizer level		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC

TABLE D1.9. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria (continued)</u>								
Injection water availability [ADO ADO ADO ADO] (partial)	RCS injection water tanks inventories		Tank levels (SIT, RWST, VCT)		AVI	AVI	AVI	AVI
					AVI	FEC	FEC	FEC
	Containment sump inventory		Sump levels		AVI	FEC	FEC	FEC
<u>Strategy Initiation</u>								
Injection pump flow HPSI/LPSI/CP [ADO ADO ADO ADO]	Injection pump flow rate		Flow indication		AVI	AVI	AVI	AVI
			Pump outlet pressure		AVI	AVI	AVI	AVI
			Pump motor current		AVI	AVI	AVI	AVI
Injection water availability (decreasing) [ADO ADO ADO ADO] (partial)	RCS injection water tanks inventories		Tank level (SIT, RWST, VCT)		AVI	AVI	AVI	AVI
					AVI	FEC	FEC	FEC

TABLE D1.9. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Strategy Effectiveness</u>								
	RCS inventory history [AIO NAV NAV NAV]	None		None					
			Pressurizer inventory	Pressurizer level		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
	<u>Selection Criteria</u>								
RCS Inventory Sources Strategies	Inventory availability	Tank inventories		Tank level					
	Pumping capability	Electric power availability							
		Steam availability							
	Alignment capability	Valve alignments		Valve position indicators					

TABLE D1.9. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Initiation</u>								
Injection water inventory (decreasing) [ADO ADO ADO ADO]	Tank inventory		Tank level (SIT, RWST)		AVI FEC	AVI FEC	AVI FEC	AVI FEC
Feedwater flow status [ADO ADO ADO ADO]	Feedwater flow rate		Feedwater flow rate		AVI	AVI	AVI	AVI
<u>Strategy Effectiveness</u>								
RCS fluid temperature [ADO NAV NAV NAV]	RCS fluid temperature		Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
Secondary fluid inventory [ADO ADO ADO NAV]	Secondary liquid level		Secondary liquid level		AVI	AVI	AVI	FEC

TABLE D1.10. CHANGE IN CORE GEOMETRY MECHANISM (V2B1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Selection Criteria</u>								
Maintain Core Heat Removal Safety Function	Core heat removal	None		None					
	[AIO NAV NAV NAV]		Fuel rod temperature	None					
			Core exit temperature history	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity level	RCS sampling system		AVI	AVI	AVI	AVI
	<u>Indicators</u>								
Change in Core Geometry Mechanism (V2B1)	Core material temperature and geometry	Cladding and fuel location and temperature		None	Cladding temperature thermocouple	NI	NI	NI	NI
	[ADO NAV NAV NAV]		Fuel relocation to lower plenum	Source range monitor		AVI	FEC	FEC	FEC
	<u>Precursors</u>								
	High cladding temperature [AIO AIO AIO AIO]	Cladding and fuel temperature		None	Cladding temperature thermocouple	NI	NI	NI	NI

TABLE D1.10. (continued)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
Information Needs						1	2	3	4
<u>Precursors (continued)</u>									
			Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC
			Cladding temperature	SPNDs		AVI	FEC	FEC	FEC
			Coolant activity level	RCS sampling system		AVI	AVI	AVI	AVI
<u>Selection Criteria</u>									
RCS Pump Restart Strategy	RCS flow status	RCS flow rate		RCS flow rate		FEC	FEC	FEC	FEC
	[NAV NAV NAV NAV]	RCS pump speed		RCS pump speed		FEC	FEC	FEC	FEC
		RCS pump differential pressure		RCS pump differential pressure		FEC	FEC	FEC	FEC
	Fuel rod cladding temperature	None		None					
	[AIO NAV NAV NAV]		Core exit temperature	Core exit thermocouple		ANI	FEC	FEC	FEC

TABLE D1.10. (continued)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
Information Needs		Source	Source	Instruments	Instruments	1	2	3	4
<u>Strategy Initiation</u>									
RCS flow status [NAV NAV NAV NAV]		RCS flow rate		RCS flow rate		FEC	FEC	FEC	FEC
<u>Strategy Effectiveness</u>									
RCS flow status [NAV NAV NAV NAV]		RCS flow rate		RCS flow rate		FEC	FEC	FEC	FEC
Fuel rod cladding temperature [AIO NAV NAV NAV]		None	Core exit temperature	None Core exit thermocouple		AVI	FEC	FEC	FEC
<u>Selection Criteria</u>									
RCS Injection Methods Strategies	RCS pressure history [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	RCS inventory (trend) [AIO NAV NAV NAV]	None		None					
			Pressurizer inventory	Pressurizer level		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC

TABLE D1.10. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria (continued)</u>								
Injection water availability [ADO ADO ADO ADO] (partial)	RCS injection water tanks		Tank levels (SIT, RWST, VCT)		AVI	AVI	AVI	AVI
	inventories				AVI	FEC	FEC	FEC
	Containment sump inventory		Sump levels		AVI	FEC	FEC	FEC
<u>Strategy Initiation</u>								
Injection pump flow HPSI/LPSI/CP [ADO ADO ADO ADO]	Injection pump flow rate		Flow indication		AVI	AVI	AVI	AVI
			Pump outlet pressure		AVI	AVI	AVI	AVI
			Pump motor current		AVI	AVI	AVI	AVI
Injection water availability (decreasing) [ADO ADO ADO ADO] (partial)	RCS injection water tanks inventories		Tank level (SIT, RWST, VCT)		AVI	AVI	AVI	AVI
					AVI	FEC	FEC	FEC

TABLE D1.10. (continued)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
Information Needs						1	2	3	4
<u>Strategy Effectiveness</u>									
RCS inventory history [AIO NAV NAV NAV]		None		None					
			Pressurizer inventory	Pressurizer level		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
<u>Strategy Criteria</u>									
RCS Inventory Sources Strategies	Inventory availability [ADO ADO ADO ADO]	Tank inventories		Tank level (SIT, RWST)		AVI FEC	AVI FEC	AVI FEC	AVI FEC
	Pumping capability		Electric power availability						
			Steam availability						
	Alignment capability	Valve alignments		Valve position indicators					

TABLE D1.10. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Initiation</u>								
Injection water inventory (decreasing) [ADO ADO ADO ADO]	Tank inventory		Tank level (SIT, RWST)		AVI FEC	AVI FEC	AVI FEC	AVI FEC
Feedwater flow status [ADO ADO ADO ADO]	Feedwater flow rate		Feedwater flow rate		AVI	AVI	AVI	AVI
<u>Strategy Effectiveness</u>								
RCS fluid temperature [ADO NAV NAV NAV]	RCS fluid temperature		Hot or cold leg RTDs, CETs		AVI	FEC	FEC	FEC
Secondary fluid inventory [ADO ADO ADO NAV]	Secondary liquid level		Secondary liquid level		AVI	AVI	AVI	FEC

TABLE D1.11. PREVENT VESSEL FAILURE (V) - COOLABLE RELOCATION MECHANISM (V3A1)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
Information Needs						1	2	3	4
Maintain vessel boundary safety function (V3)	Vessel integrity [AIO NAV NAV NAV]	Vessel visual observation		None	Camera for vessel observation	NI	NI	NI	NI
			Vessel wall temperature	None	Vessel temperature sensor	NI	NI	NI	NI
			RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC
<u>Indicators</u>									
Coolable relocation mechanism (V3A1)	Vessel integrity [AIO NAV NAV NAV]	Vessel visual observation		None	Camera for vessel observation	NI	NI	NI	NI
			Vessel wall temperature	None	Vessel temperature sensor				
			RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC
<u>Precursors</u>									
	Core relocation status [AIO NAV NAV NAV]	None		None					
			Radiation levels outside core region	Source range monitor		AVI	FEC	FEC	FEC
			RCS pressure (rise)	Pressurizer pressure		AVI	FEC	FEC	FEC
			Cold leg temperature	Cold leg RTDs, CETs		AVI	FEC	FEC	FEC

TABLE D1.11. (continued)

Information Needs				Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
								1	2	3	4
<u>Precursors (Continued)</u>											
Core damage status [AIO AIO AIO AIO]	None			None	Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC
								AVI	FEC	FEC	FEC
								AVI	FEC	FEC	FEC
								AVI	AVI	AVI	AVI
<u>Selection Criteria</u>											
Injection into RCS strategy	RCS pressure history [ADO NAV NAV NAV]			RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	RCS inventory (trend) [AIO NAV NAV NAV]							AVI	FEC	FEC	FEC
				Pressurizer inventory		Pressurizer level		AVI	FEC	FEC	FEC
								AVI	FEC	FEC	FEC
				Reactor vessel inventory		RV LMS		AVI	FEC	FEC	FEC
								AVI	FEC	FEC	FEC
Injection water availability [ADO ADO ADO ADO] (partial)	RCS injection water tanks inventories					Tank levels (SIT, RWST, VCT)		AVI	AVI	AVI	AVI
								AVI	FEC	FEC	FEC
	Containment sump inventory					Sump levels		AVI	FEC	FEC	FEC

TABLE D1.11. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Initiation</u>								
Injection pump flow HPSI/LPSI/CP [ADO ADO ADO ADO]	Injection pump flow rate		Flow indication		AVI	AVI	AVI	AVI
			Pump outlet pressure		AVI	AVI	AVI	AVI
			Pump motor current		AVI	AVI	AVI	AVI
Injection water availability (decreasing) [ADO ADO ADO ADO] (partial)	RCS injection water tanks inventories		Tank level (SIT, RWST, VCT)		AVI	AVI	AVI	AVI
					AVI	FEC	FEC	FEC
<u>Strategy Effectiveness</u>								
RCS inventory history [AIO NAV NAV NAV]	None		None					
			Pressurizer inventory	Pressurizer level	AVI	FEC	FEC	FEC
		Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
Cladding temperature [AIO NAV NAV NAV]	None		None	Cladding temperature thermocouple				
			Core exit temperature	Core exit thermocouples	AVI	FEC	FEC	FEC

TABLE D1.11. (continued)

Information Needs		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
						1	2	3	4
<u>Selection Criteria</u>									
RCS heat removal strategy using steam generator	RCS pressure (high)	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	[ADO NAV NAV NAV] RCS temperature history	RCS coolant temperature		Hot and cold leg RTDs, CETs		AVI	FEC	FEC	FEC
	[ADO NAV NAV NAV] RCS inventory (decreasing)	None		None					
	[AIO NAV NAV NAV]		Pressurizer inventory	Pressurizer level		AVI	FEC	FEC	FEC
			Reactor vessel level	RVLMS		AVI	FEC	FEC	FEC
	Steam generator secondary pressure history	Steam generator secondary pressure		Secondary pressure		AVI	AVI	AVI	FEC
	[ADO ADO ADO NAV] Steam generator inventory	Steam generator secondary level		Secondary level		AVI	AVI	AVI	FEC
	[ADO ADO ADO NAV]	Feedwater source and alternate system feedwater status	Auxiliary, main	Status instrumentation (MFW flow, AFW flow)		FSS AVI	FSS AVI	FSS AVI	FSS AVI
	Availability								
	[ADO ADO ADO ADO]	Feedwater tank inventory		Tank level (Condensate storage tank, Demineralized water storage tank)		AVI	AVI	AVI	AVI

TABLE D1.11. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy initiation</u>								
Steam generator secondary pressure history [ADO ADO ADO NAV]	Steam generator secondary pressure		Secondary pressure		AVI	AVI	AVI	FEC
Feedwater flow [ADO ADO ADO ADO]	Feedwater flow rate		Feedwater flow rate (MFW flow AFW flow)		FSS AVI	FSS AVI	FSS AVI	FSS AVI
			Pump discharge pressure		AVI	AVI	AVI	AVI
			Pump motor current		AVI	AVI	AVI	AVI
<u>Strategy Effectiveness</u>								
RCS pressure history [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
RCS temperature history [ADO NAV NAV NAV]	RCS coolant temperature		Subcooled margin monitor		AVI	FEC	FEC	FEC
			Cold and hot leg RTDs, CETs		AVI	FEC	FEC	FEC

TABLE D1.11. (continued)

Information Needs	Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase				
					1	2	3	4	
Strategy Effectiveness (Continued)									
Core temperature [AIO NAV NAV NAV]	None		None	Cladding temperature thermocouple	NI	NI	NI	NI	
		Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC	
Selection Criteria									
RCS heat removal strategy using PORVs	RCS pressure (high) [ADO NAV NAV NAV]	RCS pressure		Pressurizer Pressure	AVI	FEC	FEC	FEC	
	RCS inventory (decreasing) [ADI NAV NAV NAV]	None		None					
			Pressurizer inventory	Pressurizer level	AVI	FEC	FEC	FEC	
			Reactor vessel inventory	RVLMS	AVI	FEC	FEC	FEC	
Strategy Initiation									
PORV flow (confirmation) [AIO AIO AIO NAV]	None		None	PORV flow sensor					
		RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC	
		PORV discharge pipe temperature	PORV discharge pipe thermocouple						

TABLE D1.11. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Initiation (Continued)</u>								
		PORV discharge pipe noise	Acoustic monitors		AVI	AVI	AVI	FEC
		Quench tank inventory	Quench tank level		FSS	FSS	FSS	FSS
<u>Strategy Effectiveness</u>								
RCS pressure history	RCS pressure		Pressurizer					pres sure AV I FE C FE C FE C
[ADO NAV NAV NAV] RCS temperature history	RCS coolant temperature		Subcooled margin monitor		AVI	FEC	FEC	FEC
[ADO NAV NAV NAV]			Cold and hot leg RTDs, CETs		AVI	FEC	FEC	FEC
Cladding temperature	None		None	Cladding temperature thermocouple	NI	NI	NI	NI
[ADO NAV NAV NAV]		Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC

TABLE D1.12. PREVENT VESSEL FAILURE (V)--NONCOOLABLE RELOCATION MECHANISM (V3A2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain vessel boundary function (V3)	Vessel integrity [AIO NAV NAV NAV]	Vessel visual observation		None	Camera for vessel observation	NI	NI	NI	NI
			Vessel wall temperature	None	Vessel temperature sensor	NI	NI	NI	NI
			RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC
	<u>Indicators</u>								
Relocation mechanism (V3A2)	High vessel wall temperature [NAV NAV NAV NAV]	Vessel wall temperature		None	Vessel temperature sensor	NI	NI	NI	NI
	<u>Precursors</u>								
	Core relocation status [AIO NAV NAV NAV]	None		None					
			Radiation levels outside core region	Source range monitor		AVI	FEC	FEC	FEC
			RCS pressure (rise)	Pressurizer pressure		AVI	FEC	FEC	FEC
			Cold leg temperature	Cold leg RTDs, CETs		AVI	FEC	FEC	FEC

TABLE D1.12. (continued)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
<u>Information Needs</u>		<u>Source</u>	<u>Source</u>	<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Precursors (continued)</u>									
	Core damage status [AIO AIO AIO AIO]	None		None					
			Core exit temperature	Core exit temperature		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity	RCS sampling system		AVI	AVI	AVI	AVI
<u>Selection Criteria</u>									
Flood cavity strategy	Vessel visual observation [NAV NAV NAV NAV]			None	Camera for vessel observation	NI	NI	NI	NI
	Vessel integrity [AIO NAV NAV NAV]	Vessel wall temperature		None	Vessel temperature sensor	NI	NI	NI	NI
			RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC
	Core relocation status [AIO NAV NAV NAV]	None		None					
			Radiation levels outside core region	Source range monitors		AVI	FEC	FEC	FEC

TABLE D1.12. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria (continued)</u>								
		RCS pressure rise	Pressurizer pressure		AVI	FEC	FEC	FEC
		Cold leg temperature	Cold leg RTDs, CETs		AVI	FEC	FEC	FEC
Core damage status [AIO AIO AIO AIO]	None		None					
		Core exit temperature	Core exit temperature		AVI	FEC	FEC	FEC
		Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
		RCS coolant activity	RCS sampling system		AVI	AVI	AVI	AVI
Inventory available to flood cavity [NAV NAV NAV NAV]	Cavity flooding system tank inventory			Tank levels	NI	NI	NI	NI

TABLE D1.12. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Initiation</u>								
Inventory available to flood cavity [NAV NAV NAV NAV]	Cavity flooding system tank inventory			Tank levels	NI	NI	NI	NI
Flow to Cavity [NAV NAV NAV NAV]	Cavity flooding system flow rate			Flow rate	NI	NI	NI	NI
<u>Strategy Effectiveness</u>								
Vessel wall temperature [NAV NAV NAV NAV]	Vessel wall temperature		None	Vessel temperature sensor	NI	NI	NI	NI

TABLE D2.1. PREVENT CONTAINMENT FAILURE (C)--INSUFFICIENT ENERGY REMOVAL MECHANISM (C1A1)

	<u>Information Needs</u>	Direct	Indirect	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
		<u>Information Source</u>	<u>Information Source</u>			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain pressure control safety function (C1)	Containment pressure history [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
	<u>Indicators</u>								
Insufficient energy removal mechanism (C1A1)	Imbalance in energy addition and removal [AIO AIO AIO AIO]	None		None					
			Containment	Containment pressure history	pressure	AVI	AVI	AVI	AVI
			Containment atmosphere temperature	Containment atmosphere temperature		AVI	AVI	AVI	AVI
			Containment humidity	Humidity detector		FEC	FEC	FEC	FEC
	<u>Precursors</u>								
	RCS leak integrity (status) [ADI NAV NAV NAV]	RCS pressure history		Pressurizer pressure		AVI	FEC	FEC	FEC
		RCS inventory history		Pressurizer level		AVI	FEC	FEC	FEC
				RVLMS		AVI	FEC	FEC	FEC

TABLE D2.1. (continued)

	<u>Information Needs</u>	Direct	Indirect	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
		<u>Information Source</u>	<u>Information Source</u>			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Precursors (continued)</u>									
	Steam generator secondary system integrity (status) [ADO ADO ADO NAV]	Steam generator secondary pressure history		Secondary pressure		AVI	AVI	AVI	FEC
		Steam generator secondary level history		Secondary level, steam flow/feed flow mismatch		AVI	AVI	AVI	FEC
	Containment heat removal systems capability (status) [ADO ADO ADO ADO]	Containment heat removal system equipment status		Systems flow, temperature, and pressure		AVI	AVI	AVI	AVI
<u>Selection Criteria</u>									
Fan cooler systems strategy	Containment atmosphere temperature [ADO ADO ADO NAV]	Containment atmosphere temperature		Containment atmosphere temperature		AVI	AVI	AVI	FEC
	Containment pressure history [ADO ADO ADO ADO]	Containment pressure record		Containment pressure		AVI	AVI	AVI	AVI
<u>Strategy Initiation</u>									
	Fan and cooling system operation [ADO ADO ADO ADO]	Fan cooling system status indicators		System status indicators		AVI	AVI	AVI	AVI

TABLE D2.1. (continued)

Information Needs	Direct	Indirect	Available	Potential	Status in Phase				
	Information	Information			Instruments	Instruments	1	2	3
	Source	Source							
<u>Strategy Effectiveness</u>									
Containment pressure history [ADO ADO ADO ADO]	Containment pressure record		Containment pressure		AVI	AVI	AVI	AVI	
Containment atmosphere temperature [ADO ADO ADO NAV]	Containment atmosphere temperature		Containment atmosphere temperature		AVI	AVI	AVI	FEC	
Heat exchanger effectiveness [ADO ADO ADO ADO]	Fan cooling system heat exchanger differential temperature		Heat exchanger inlet and outlet temperature		AVI	AVI	AVI	AVI	
<u>Selection Criteria</u>									
Spray systems strategy	Containment pressure history [ADO ADO ADO ADO]	Containment pressure	Containment pressure		AVI	AVI	AVI	AVI	
	Spray water availability [ADO ADO ADO ADO]	Spray water tank inventory	Tank level		AVI	AVI	AVI	AVI	
	(partial)	Containment sump inventory	Sump Level		AVI	AVI	AVI	FEC	
	Containment atmosphere temperature [ADO ADO ADO NAV]	Containment atmosphere temperature	Containment atmosphere temperature		AVI	AVI	AVI	FEC	

TABLE D2.1. (continued)

<u>Information Needs</u>	Direct	Indirect	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
	<u>Information Source</u>	<u>Information Source</u>			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Initiation</u>								
Containment pressure [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
Spray flow initiation [ADO ADO ADO ADO]	Spray flow indicators		Pump discharge pressure		AVI	AVI	AVI	AVI
			Pump motor current					
			Spray flow rate					
<u>Strategy Effectiveness</u>								
Containment pressure history [ADO ADO ADO ADO]	Containment pressure record		Containment pressure		AVI	AVI	AVI	AVI
Containment atmosphere temperature [ADO ADO ADO NAV]	Containment atmosphere temperature		Containment atmosphere temperature		AVI	AVI	AVI	FEC

TABLE D2.1. (continued)

		Direct	Indirect	Available	Potential	Status in Phase			
Information Needs		Information	Information	Instruments	Instruments	1	2	3	4
Source		Source	Source						
<u>Selection Criteria</u>									
Vent strategy	Containment pressure history [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
	Presence of radiation in containment [NAV NAV NAV NAV]	Containment radiation level		Containment radiation monitors		FSS	FSS	FSS	FSS
	Containment humidity	Containment humidity		Humidity detectors		FEC	FEC	FEC	FEC
<u>Strategy Initiation</u>									
	Vent system initiation [NAV NAV NAV NAV]	Vent system flow rate			Vent system flow measurement	NI	NI	NI	NI
<u>Strategy Effectiveness</u>									
	Containment pressure history [ADO ADO ADO ADO]	Containment pressure record		Containment pressure		AVI	AVI	AVI	AVI
	Containment atmosphere temperature [ADO ADO ADO NAV]	Containment atmosphere temperature		Containment atmosphere temperature		AVI	AVI	AVI	AVI

TABLE D2.2. PREVENT CONTAINMENT FAILURE (C)--NONCONDENSABLE GAS BUILDUP MECHANISM (C1A2)

	Information Needs	Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
						1	2	3	4
Maintain pressure control safety function (C1)	Containment pressure history [ADO ADO ADO ADO]	Containment pressure record		Containment pressure		AVI	AVI	AVI	AVI
<u>Indicators</u>									
Noncondensable gas buildup mechanism (C1A2)	Concentration of noncondensables (high) [ADI ADI ADI ADI]	Containment hydrogen concentration		Hydrogen monitoring system		AVI	AVI	AVI	AVI
		Containment noble gas concentration		Noble gas monitoring system		FSS	FSS	FSS	FSS
			Containment pressure	Containment pressure		AVI	AVI	AVI	AVI
			Air and nitrogen equipment status	Equipment status indicators		FEC	FEC	FEC	FEC
<u>Precursors</u>									
	RCS leak integrity (status) [ADO NAV NAV NAV]	RCS pressure history		Pressurizer pressure		AVI	FEC	FEC	FEC
		RCS inventory history		Pressurizer level		AVI	FEC	FEC	FEC
				RVLMS		AVI	FEC	FEC	FEC

TABLE D2.2. (continued)

					Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase				
					Information Needs					1	2	3	4
<u>Precursors (continued)</u>													
					Core damage status [AIO AIO AIO AIO]	None		None					
							Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC
							Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
							RCS coolant activity	RCS sampling system		AVI	AVI	AVI	AVI
<u>Selection Criteria</u>													
Vent strategy	Containment pressure history [ADO ADO ADO ADO]				Containment pressure record		Containment pressure		AVI	AVI	AVI	AVI	
	Hydrogen gas concentration [ADO ADO ADO ADO]				Containment hydrogen concentration		Hydrogen gas monitor		AVI	AVI	AVI	AVI	
	Noble gas concentration [NAV NAV NAV NAV]				Containment noble gas concentration		Noble gas monitor		FSS	FSS	FSS	FSS	
	Presence of radiation in containment [NAV NAV NAV NAV]				Containment radiation level		Containment radiation monitors		FSS	FSS	FSS	FSS	

TABLE D2.2. (continued)

<u>Information Needs</u>	Direct	Indirect	<u>Available</u>	<u>Potential</u>	<u>Status in Phase</u>				
	<u>Information</u>	<u>Information</u>			<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>	<u>3</u>
	<u>Source</u>	<u>Source</u>							
<u>Selection Criteria (continued)</u>									
Containment humidity [NAV NAV NAV NAV]	Containment humidity		Humidity detectors		FEC	FEC	FEC	FEC	
<u>Strategy Initiation</u>									
Vent system flow [NAV NAV NAV NAV]	Vent system flow rate			Vent system flow measurement	NI	NI	NI	NI	
<u>Strategy Effectiveness</u>									
Containment pressure history [ADO ADO ADO ADO]	Containment pressure record		Containment pressure		AVI	AVI	AVI	AVI	
Hydrogen gas concentration [ADO ADO ADO ADO]	Containment hydrogen concentration		Hydrogen gas monitor		AVI	AVI	AVI	AVI	
Noble gas concentration [NAV NAV NAV NAV]	Containment noble gas concentration		Noble gas monitor		FSS	FSS	FSS	FSS	

TABLE D2.2. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria</u>									
Recombiners/ igniters strategy	Containment pressure history [ADO ADO ADO ADO]	Containment pressure record		Containment pressure		AVI	AVI	AVI	AVI
	Hydrogen gas concentration [ADO ADO ADO ADO]						AVI	AVI	AVI
<u>Strategy Initiation</u>									
	Initiation of recombiners/ igniters	Recombiners/ igniters equipment status		Status indicators		AVI	AVI	AVI	AVI
<u>Strategy Effectiveness</u>									
	Hydrogen gas concentration [ADO ADO ADO ADO]	Containment hydrogen concentration		Hydrogen gas monitor		AVI	AVI	AVI	AVI
	Containment pressure history [ADO ADO ADO ADO]	Containment pressure record		Containment pressure		AVI	AVI	AVI	AVI

TABLE D2.3. PREVENT CONTAINMENT FAILURE (C)--DIRECT CONTAINMENT HEATING MECHANISM (C1B1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain pressure control safety function (C1)	Containment pressure history [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
	<u>Indicators</u>								
Direct containment heating mechanism (C1B1)	Containment pressure history [ADO ADO ADO ADO]	Containment Pressure record		Containment pressure		AVI	AVI	AVI	AVI
	Containment temperature history [ADO ADO ADO NAV]	Containment atmosphere temperature		Containment thermocouples		AVI	AVI	AVI	FEC
	Containment radiation level [NAV NAV NAV NAV]	Containment radiation level		Containment radiation monitor		FSS	FSS	FSS	FSS
	<u>Precursors</u>								
	RCS pressure (high) [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	Approach to vessel failure [AIO NAV NAV NAV]	Vessel visual observation		None	Camera for vessel observation	NI	NI	NI	NI
			Vessel wall temperature	None	Vessel temperature sensor	NI	NI	NI	NI
			RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC

TABLE D2.3. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Precursors (continued)</u>								
	Core damage status [AIO AIO AIO AIO]	None		None					
			Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity	RCS sampling system		AVI	AVI	AVI	AVI
	<u>Selection Criteria</u>								
Depressurize RCS strategy	RCS pressure history [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	Steam generator heat removal capability [ADO ADO ADO ADO] (partial)	Steam generator secondary pressure		Steam generator pressure		AVI	AVI	AVI	FEC
		Steam generator secondary level		Steam generator liquid level		AVI	AVI	AVI	FEC
		Feedwater tank inventory		Tank levels		AVI	AVI	AVI	AVI
		Auxiliary, main and alternate feed-water system status		Equipment status (MFW flow AFW flow)		FSS AVI	FSS AVI	FSS AVI	FSS AVI

TABLE D2.3. (continued)

<u>Information Needs</u>	<u>Direct</u>	<u>Indirect</u>	<u>Available</u>	<u>Potential</u>	<u>Status in Phase</u>				
	<u>Information</u>	<u>Information</u>			<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>	<u>3</u>
	<u>Source</u>	<u>Source</u>							
<u>Selection Criteria (continued)</u>									
Core damage status	None		None						
[AIO AIO AIO AIO]		Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC	
		Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC	
		RCS coolant activity	RCS sampling system		AVI	AVI	AVI	AVI	
<u>Strategy Initiation</u>									
RCS pressure history	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC	
[ADO NAV NAV NAV]									
Steam generator secondary pressure	Steam generator secondary pressure		Steam generator pressure		AVI	AVI	AVI	FEC	
[ADO ADO ADO NAV]									
PORV flow (confirmation)		PORV discharge Pipe temperature	PORV discharge pipe thermocouple						
[AIO AIO AIO NAV]									
		PORV flow	Acoustic monitors		AVI	AVI	AVI	FEC	
		Quench tank inventory	Quench tank level		FSS	FSS	FSS	FSS	

TABLE D2.3. (continued)

	<u>Information Needs</u>	Direct	Indirect	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
		Information	Information			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
		<u>Source</u>	<u>Source</u>						
<u>Strategy Effectiveness</u>									
	RCS pressure [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	Containment pressure [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
<u>Selection Criteria</u>									
Vent strategy	Containment pressure [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
	RCS pressure [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	Core damage status [AIO AIO AIO AIO]	None		None					
			Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity	RCS sampling system		AVI	AVI	AVI	AVI
		Presence of radiation in containment [NAV NAV NAV NAV]	Containment radiation level		Containment radiation monitors		FSS	FSS	FSS

TABLE D2.3. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Strategy Initiation</u>								
	Vent system flow [NAV NAV NAV NAV]	Vent system flow rate		Vent system flow measurement		NI	NI	NI	NI
	<u>Strategy Effectiveness</u>								
	Containment pressure [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
	<u>Selection Criteria</u>								
Flood cavity strategy	RCS pressure [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	Core damage status [AIO AIO AIO AIO]	None		None					
			Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity	RCS sampling system		AVI	AVI	AVI	AVI
	Cavity inventory [NAV NAV NAV NAV]	Cavity inventory		None	Cavity level sensor	NI	NI	NI	NI
	Inventory available to flood cavity [NAV NAV NAV NAV]	Cavity flooding system tank inventory			Tank levels	NI	NI	NI	NI

TABLE D2.3. (continued)

	<u>Information Needs</u>	<u>Direct</u>	<u>Indirect</u>	<u>Available</u>	<u>Potential</u>	<u>Status in Phase</u>			
		<u>Information</u>	<u>Information</u>			<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>
		<u>Source</u>	<u>Source</u>						
<u>Strategy Initiation</u>									
	Flow to cavity [NAV NAV NAV NAV]	Cavity flooding system			Flow measurement	NI	NI	NI	NI
	Inventory available to flood cavity [NAV NAV NAV NAV]	Cavity flooding system inventory			Tank levels	NI	NI	NI	NI
<u>Strategy Effectiveness</u>									
	Containment pressure [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
<u>Selection Criteria</u>									
Add barriers strategy	None-passive system								
<u>Strategy Initiation</u>									
	None-passive system								

TABLE D2.4. PREVENT CONTAINMENT FAILURE (C)--COMBUSTABLE GAS DETONATION MECHANISM (C1B2)

	Information Needs	Direct	Indirect	Available	Potential	Status in Phase			
		Information	Information			Instruments	Instruments	1	2
Strategy Effectiveness									
Maintain pressure control safety function (C1)	Containment pressure [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
	Containment Pressure history [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
Indicators									
Combustible gas detonation mechanism (C1B2)	Containment pressure history [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
	Containment atmosphere temperature history [ADO ADO ADO NAV]	Containment atmosphere temperature		Containment temperature		AVI	AVI	AVI	FEC
Precursors									
	Hydrogen gas concentration (increasing) [ADO ADO ADO ADO]	Containment hydrogen concentration		Hydrogen monitoring system		AVI	AVI	AVI	AVI
	Containment radiation level [NAV NAV NAV NAV]	Containment radiation		Containment radiation monitors		FSS	FSS	FSS	FSS
	Core damage [AIO AIO AIO AIO]	None		None					
			Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC

TABLE D2.4. (continued)

<u>Information Needs</u>		<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Precursors (continued)</u>									
			Reactor vessel level	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity	RCS sampling system		AVI	AVI	AVI	AVI
<u>Selection Criteria</u>									
Recombiners/ igniters strategy	Hydrogen gas concentration [ADO ADO ADO ADO]	Containment hydrogen concentration		Hydrogen monitoring system		AVI	AVI	AVI	AVI
	Containment pressure history [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
<u>Strategy Initiation</u>									
	Initiation of recombiners/ igniters	Recombiners/ igniters equipment status		Status indicator		AVI	AVI	AVI	AVI
<u>Strategy Effectiveness</u>									
	Hydrogen gas concentration [ADO ADO ADO ADO]	Containment hydrogen concentration		Hydrogen monitoring system		AVI	AVI	AVI	AVI

TABLE D2.4. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Vent strategy	Containment pressure history [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
	<u>Selection Criteria</u>								
	Hydrogen gas concentration [ADO ADO ADO ADO]	Containment hydrogen concentration		Hydrogen monitoring system					
	Containment pressure [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
	Presence of radiation in containment [NAV NAV NAV NAV]	Containment radiation level		Containment radiation monitors		FSS	FSS	FSS	FSS
	<u>Strategy Initiation</u>								
	Vent system flow [NAV NAV NAV NAV]	Vent system flow rate			Vent system flow measurement	NI	NI	NI	NI
	<u>Strategy Effectiveness</u>								
	Hydrogen gas concentration [ADO ADO ADO ADO]	Containment hydrogen concentration		Hydrogen monitoring system		AVI	AVI	AVI	AVI
	Containment pressure [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI

TABLE D2.5. PREVENT CONTAINMENT FAILURE (C)--STEAM EXPLOSION MECHANISM (C1B3)

	Information Needs	Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
						1	2	3	4
Maintain pressure control safety function (C1)	Containment pressure history [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
	<u>Indicators</u>								
Steam explosion mechanism (C1B3)	Containment pressure history [AIO AIO AIO AIO]	None	Containment pressure	Containment pressure		AVI	AVI	AVI	AVI
	Containment atmosphere temperature history [AIO AIO AIO AIO]	None	Containment atmosphere temperature	Containment thermocouples		AVI	AVI	AVI	FEC
	Containment radiation level [NAV NAV NAV NAV]	None	Containment radiation level	Containment radiation monitors		FSS	FSS	FSS	FSS
	<u>Precursors</u>								
	Vessel integrity [NAV NAV NAV NAV]	Vessel visual observation		None	Camera for vessel observation	NI	NI	NI	NI
			Vessel wall temperature	None	Vessel temperature sensor	NI	NI	NI	NI
			RCS (vessel) pressure	Pressurizer pressure		AVI	FEC	FEC	FEC

TABLE D2.5. (continued)

	<u>Information Needs</u>	Direct	Indirect	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
		Information	Information			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
		Source	Source						
<u>Precursors (continued)</u>									
	Core relocation status [AIO NAV NAV NAV]	None		None					
			Radiation levels outside core region	Source range monitors		AVI	FEC	FEC	FEC
	Core damage status [AIO AIO AIO AIO]	None		None					
			Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel level	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity	RCS sampling		AVI	AVI	AVI	AVI
	Water in Cavity [NAV NAV NAV NAV]	Cavity inventory	None	None	Cavity level sensor	NI	NI	NI	NI
<u>Selection Criteria</u>									
Eliminate water strategy	Cavity inventory [NAV NAV NAV NAV]	Cavity inventory		None	Cavity level sensor	NI	NI	NI	NI
	Core damage status [AIO AIO AIO AIO]	None		None					
			Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC

TABLE D2.5. (continued)

<u>Information Needs</u>	<u>Direct</u>	<u>Indirect</u>	<u>Available</u>	<u>Potential</u>	<u>Status in Phase</u>				
	<u>Information</u>	<u>Information</u>			<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>	<u>3</u>
	<u>Source</u>	<u>Source</u>							
<u>Selection Criteria (continued)</u>									
		RCS coolant activity	RCS sampling system		AVI	AVI	AVI	AVI	
<u>Strategy Initiation</u>									
Water flow from cavity [NAV NAV NAV NAV]	Cavity drain system flow rate			Flow measurement	NI	NI	NI	NI	
<u>Strategy Effectiveness</u>									
Cavity water inventory [NAV NAV NAV NAV]	Cavity inventory		None		NI	NI	NI	NI	
Containment pressure [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI	

TABLE D2 5 (continued)

		Direct	Indirect	Available	Potential	Status in Phase			
<u>Information Needs</u>		<u>Information Source</u>	<u>Information Source</u>	<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria</u>									
Add barriers strategy	None-passive system								
<u>Strategy Initiation</u>									
None-passive system									
<u>Strategy Effectiveness</u>									
Containment pressure [ADO ADO ADO ADO]		Containment pressure		Containment pressure		AVI	AVI	AVI	AVI

TABLE D2.6. PREVENT CONTAINMENT FAILURE (C)--ENERGY ADDITION AT VESSEL FAILURE MECHANISM (C1B4)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain pressure control safety function (C1)	Containment pressure history [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
Energy Addition at vessel failure mechanism (C1B4)	<u>Indicators</u>								
	Containment pressure history [ADO ADO ADO ADO]	Containment pressure record		Containment pressure		AVI	AVI	AVI	AVO
	Containment atmosphere temperature history [ADO ADO ADO NAV]	Containment atmosphere temperature		Containment thermocouples		AVI	AVI	AVI	FEC
	Containment radiation level [NAV NAV NAV NAV]	Containment radiation level		Containment radiation monitor		FSS	FSS	FSS	FSS
	<u>Precursors</u>								
	RCS Pressure (high) [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
Prevent vessel failure strategy	See Table A1.11, RCS heat removal strategies using steam generator and PORV and injection into RCS strategy to prevent vessel failure.								
Insufficient energy removal strategy	See Table A2.1, spray system, fan cooler, and vent strategies to reduce pressure prior to vessel failure.								

TABLE D2.7. PREVENT CONTAINMENT FAILURE (C)--TEMPERATURE INDUCED DEGRADATION MECHANISM (C2A1)

	<u>Information Needs</u>	Direct	Indirect	<u>Available</u>	<u>Potential</u>	<u>Status in Phase</u>			
		<u>Information</u>	<u>Information</u>			<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>
Maintain temperature control safety function (C2)	Containment shell temperature history	None		None	Containment shell temperature sensor	NI	NI	NI	NI
			Containment atmosphere temperature	Containment atmosphere thermocouples	AVI	AVI	AVI	FEC	
<u>Indicators</u>									
Temperature induced degradation mechanism (C2A1)	Containment penetration integrity	None		None					
			Containment penetration temperature	None	Penetration temperature sensor	NI	NI	NI	NI
<u>Precursors</u>									
	High containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere thermocouple		AVI	AVI	AVI	FEC
<u>Selection Criteria</u>									
Fan cooler systems strategy	Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere thermocouple		AVI	AVI	AVI	FEC
<u>Strategy Initiation</u>									
	Fan and cooling system operation	Fan cooling system status		System status indicators		AVI	AVI	AVI	AVI

TABLE D2.7 (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Strategy Effectiveness</u>								
	Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere thermocouple		AVI	AVI	AVI	FEC
	<u>Selection Criteria</u>								
Spray systems strategy	Containment atmosphere temperature [ADO ADO ADO NAV]	Containment atmosphere temperature		Containment atmosphere thermocouple		AVI	AVI	AVI	FEC
	Spray water availability [ADO ADO ADO ADO] (partial)	Spray water tank inventory		Tank level		AVI	AVI	AVI	AVI
		Sump level		Sump level		AVI	AVI	AVI	FEC
	<u>Strategy Initiation</u>								
	Spray flow [ADO ADO ADO ADO]	Spray flow indicators		Spray flow indication		AVI	AVI	AVI	AVI
				Pump discharge pressure					
				Pump motor current					
	<u>Strategy Effectiveness</u>								
	Containment atmosphere temperature [ADO ADO ADO NAV]	Containment atmosphere temperature		Containment atmosphere thermocouple		AVI	AVI	AVI	FEC

TABLE D2.8. PREVENT CONTAINMENT FAILURE (C)--CORE/CONCRETE INTERACTION MECHANISM (C2B1)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
<u>Information Needs</u>						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain temperature control safety function (C2)	Containment temperature history [ADO ADO ADO NAV]	Containment temperature		Containment atmosphere and wall temperature		AVI	AVI	AVI	FEC
<u>Indicators</u>									
Core/basemat concrete interaction mechanism (C2B1)	Amount of concrete ablated [NAV NAV NAV NAV]	Basemat temperature profile		None					
<u>Precursors</u>									
	Vessel integrity status [AIO NAV NAV NAV]	High vessel wall temperature		None	Vessel temperature sensor	NI	NI	NI	NI
			Radiation level	Source range monitor		AVI	FEC	FEC	FEC
	Core damage status [AIO NAV NAV NAV]	None		None					
			Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity	RCS sampling system		AVI	AVI	AVI	AVI

TABLE D2.8. (continued)

		Direct	Indirect			Status in Phase			
<u>Information Needs</u>		<u>Information</u>	<u>Information</u>	<u>Available</u>	<u>Potential</u>				
		<u>Source</u>	<u>Source</u>	<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria</u>									
Flood cavity strategy	Core damage status	None		None					
	[AIO AIO AIO AIO]		Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel level	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity	RCS sampling		AVI	AVI	AVI	AVI
	Cavity inventory	Cavity inventory		None	Cavity level sensor	NI	NI	NI	NI
	[NAV NAV NAV NAV]				Tank levels	NI	NI	NI	NI
	Inventory available to flood vacity	Cavity flooding system tank inventory							
[NAV NAV NAV NAV]									
<u>Strategy Initiation</u>									
	Flow to cavity	Cavity flooding			Flow measurement	NI	NI	NI	NI
	[NAV NAV NAV NAV]	system flow rate							
	[NAV NAV NAV NAV]								
	Inventory available	Cavity flooding			Tank levels	NI	NI	NI	NI
	to flood cavity	system tank							
	[NAV NAV NAV NAV]	inventory							

TABLE D2.8. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Strategy Effectiveness</u>								
	Basemat integrity [AIO AIO AIO AIO]	None		None					
			Containment pressure history	Containment pressure		AVI	AVI	AVI	AVI
	<u>Selection Criteria</u>								
Add barriers strategy	None-passive system								
	<u>Strategy Initiation</u>								
	None-passive system								
	<u>Strategy Effectiveness</u>								
	Basemat integrity [AIO AIO AIO AIO]	None		None					
			Containment pressure history	Containment pressure		AVI	AVI	AVI	AVI

TABLE D2.9. PREVENT CONTAINMENT FAILURE (C)--FAILURE TO ISOLATE MECHANISM (C3A1)

	<u>Information Needs</u>	Direct	Indirect	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
		<u>Information Source</u>	<u>Information Source</u>			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain integrity safety function (C1)	Containment leak rate	None		None					
			Containment pressure history	Containment pressure					
			Radiation level outside containment	Radiation monitoring system					
	Containment Leak location	None		None					
			Radiation location outside Containment	Radiation monitoring system					
	<u>Indicators</u>								
Failure to isolate mechanism (C3A1)	Containment isolation system failure location [ADO ADO ADO NAV]	Containment isolation system status		Containment isolation system status		AVI	AVI	AVI	FEC
			Containment pressure history	Containment pressure					

TABLE D2.9. (continued)

Information Needs	Direct	Indirect	Available	Potential	Status in Phase			
	Information Source	Information Source	Instruments	Instruments	1	2	3	4
<u>Indicators (continued)</u>								
		Radiation level outside containment	Radiation monitoring system		AVI	AVI	AVI	AVI
<u>Precursors</u>								
Core damage status [AIO AIO AIO AIO]	None		None					
		RCS coolant activity	Sampling system		AVI	AVI	AVI	AVI
		Core exit temperature history	Core exit thermocouples		AVF	FEC	FEC	FEC
		Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
Containment radiation level	Containment radiation level		Containment radiation monitor					
Plant specific isolation response strategy	Valve position	Plant dependant	Plant dependant	Plant dependant				

TABLE D2.9. (continued)

		Direct	Indirect	Available	Potential	Status in Phase			
Information Needs		Information	Information	Instruments	Instruments	1	2	3	4
		Source	Source						
<u>Selection Criteria</u>									
Spray systems strategy	Containment pressure history	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
	[ADO ADO ADO ADO]								
	Spray water availability	Spray water tank inventory		Tank level		AVI	AVI	AVI	AVI
	[ADO ADO ADO ADO]								
	(partial)	Containment sump inventory		Sump Level		AVI	AVI	AVI	FEC
	Containment atmosphere temperature	Containment atmosphere temperature		Containment atmosphere temperature		AVI	AVI	AVI	FEC
	[ADO ADO ADO NAV]								
<u>Strategy Initiation</u>									
	Containment pressure	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
	[ADO ADO ADO ADO]								
	Spray flow initiation	Spray flow indicators		Pump discharge pressure		AVI	AVI	AVI	AVI
	[ADO ADO ADO ADO]								
				Pump motor current					
				Spray flow rate					

TABLE D2.9. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Effectiveness</u>									
	Containment pressure history [ADO ADO ADO ADO]	Containment pressure record		Containment pressure		AVI	AVI	AVI	AVI
	Containment atmosphere temperature [ADO ADO ADO NAV]	Containment atmosphere temperature		Containment atmosphere temperature		AVI	AVI	AVI	FEC
<u>Selection Criteria</u>									
Vent strategy	Containment pressure history [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
	Presence of radiation in containment [NAV NAV NAV NAV]	Containment radiation level		Containment radiation monitors		FSS	FSS	FSS	FSS
	Containment humidity	Containment humidity		Humidity detectors		FEC	FEC	FEC	FEC
<u>Strategy Initiation</u>									
	Vent system initiation [NAV NAV NAV NAV]	Vent system flow rate			Vent system flow measurement	NI	NI	NI	NI

TABLE D2.9. (continued)

<u>Information Needs</u>	Direct	Indirect	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
	<u>Information Source</u>	<u>Information Source</u>			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Effectiveness</u>								
Containment pressure history [ADO ADO ADO ADO]	Containment pressure record		Containment pressure		AVI	AVI	AVI	AVI
Containment atmosphere temperature [ADO ADO ADO NAV]	Containment atmosphere temperature		Containment atmosphere temperature		AVI	AVI	AVI	AVI

TABLE D2.10. PREVENT CONTAINMENT FAILURE (C)--FAILURE AFTER ISOLATION MECHANISM (C3A2)

	<u>Information Needs</u>	Direct	Indirect	Available	Potential	<u>Status in Phase</u>			
		Information Source	Information Source	Instruments	Instruments	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain integrity safety function (C1)	Containment leak rate	None		None					
			Containment pressure history	Containment pressure					
			Radiation level outside containment	Radiation monitoring system					
	Containment leak location	None		None					
			Radiation location outside containment	Radiation monitoring system					
	<u>Indicators</u>								
Failure after isolation mechanism (C3A2)	Containment isolation system failure location [ADO ADO ADO NAV]	Containment isolation system status		Containment isolation system status		AVI	AVI	AVI	FEC
			Radiation level outside containment	Radiation monitoring system		AVI	AVI	AVI	AVI
			Containment pressure history	Containment pressure					

TABLE D2.10. (continued)

<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>				
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	
<u>Precursors</u>									
Core damage status [AIO AIO AIO AIO]	None		None						
		RCS coolant activity	Sampling system		AVI	AVI	AVI	AVI	
		Core exit temperature history	Core exit thermocouples		AVF	FEC	FEC	FEC	
		Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC	
<u>Selection Criteria</u>									
Reisolation strategy	Containment isolation valve position status [ADO ADO ADO ADO]	Containment isolation valve status		Valve position indicators	AVI	AVI	AVI	FEC	
<u>Strategy Initiation</u>									
	Containment isolation valves closed [ADO ADO ADO NAV]	Containment isolation valve status		Valve position indicators	AVI	AVI	AVI	FEC	
<u>Strategy Effectiveness</u>									
	Decrease in magnitude of fission product release [ADO ADO ADO ADO]	Radiation outside containment		Radiation area monitors	AVI	AVI	AVI	AVI	

TABLE D2.10. (continued)

	<u>Information Needs</u>	<u>Direct</u>	<u>Indirect</u>	<u>Available</u>	<u>Potential</u>	<u>Status in Phase</u>			
		<u>Information</u>	<u>Information</u>			<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>
<u>Selection Criteria</u>									
Depressurize containment strategy	Reisolation not possible		Containment isolation valve status	Valve position indicators		AVI	AVI	AVI	FEC
	[AIO AIO AIO NAV]								
	Fission products in containment atmosphere	Containment radiation level		Radiation monitoring system		FSS	FSS	FSS	FSS
	[NAV NAV NAV NAV]								
	Containment pressure	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI
	[ADO ADO ADO ADO]								
<u>Strategy Initiation</u>									
See Table A2.1 for spray, fan cooler, and venting strategies.									
<u>Strategy Effectiveness</u>									
	Decrease in magnitude of fission product release	Radiation outside containment		Radiation area monitors		AVI	AVI	AVI	AVI
	[ADO ADO ADO ADO]								

TABLE D2.10. (continued)

		Direct	Indirect	Available	Potential	Status in Phase			
<u>Information Needs</u>		<u>Information Source</u>	<u>Information Source</u>	<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria</u>									
Flood containment leak strategy	Leak point can be located and flooded [NAV NAV NAV NAV]	Containment leak location			Visual or camera	NI	NI	NI	NI
<u>Strategy Initiation</u>									
	Flow to leak location {NAV NAV NAV NAV]	Flow in leak flooding system			Flow meter	NI	NI	NI	NI
<u>Strategy effectiveness</u>									
	Decrease in magnitude of fission product release [ADO ADO ADO]	Radiation outside containment		Radiation monitors		AVI	AVI	AVI	AVI

TABLE D2.11. MITIGATE FISSION PRODUCT RELEASE (F)--STEAM GENERATOR TUBE RUPTURE FAILURE MECHANISM (C3B1)

	<u>Information Needs</u>	Direct	Indirect	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
		<u>Information Source</u>	<u>Information Source</u>			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain integrity safety function (C1)	Containment leak rate	None		None					
			Containment pressure history	Containment pressure					
			Radiation level outside containment	Radiation monitoring system					
	Containment leak location	None		None					
			Radiation location outside containment	Radiation monitoring system					
	<u>Indicators</u>								
SGTR mechanism (C3B1)	Presence of fission products in steam line [ADO ADO ADO ADO]	Main steam line radiation level		Steam line radiation monitoring system		AVI	AVI	AVI	AVI
			Condenser off gas radiation level		Condenser off gas radiation monitoring system	AVI	AVI	AVI	AVI
			Radiation outside containment		Radiation surveys, constant air monitor	AVI	AVI	AVI	AVI

TABLE D2.11. (continued)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
<u>Information Needs</u>						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Precursors</u>									
	Core damage status [AIO AIO AIO AIO]	None		None					
			RCS coolant activity	None		AVI	AVI	AVI	AVI
			Core exit temperature history	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
<u>Selection criteria</u>									
Depressurize RCS strategy	RCS pressure greater than ruptured generator [ADO ADO ADO ADO] (partial)	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
		Steam generator secondary pressure		Steam generator pressure		AVI	AVI	AVI	FEC
<u>Strategy Initiation</u>									
	RCS cooldown with intact generator(s) [ADI ADI ADI ADO]	Steam flow rate		Steam flow indicators		AVI	AVI	AVI	AVI
		RCS coolant temperature		cold leg RTDs, core exit thermocouples		AVI	FEC	FEC	FEC
			Steam generator secondary pressure	Pressure in intact steam generator		AVI	AVI	AVI	FEC

TABLE D2.11. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	PORV open [ADO ADO ADO NAV]	PORV position		PORV status indicator		AVI	AVI	AVI	FEC
	<u>Strategy Effectiveness</u>								
	RCS pressure decreasing [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	<u>Selection Criteria</u>								
Flood steam generator secondary strategy	Low steam generator inventory [ADO ADO ADO NAV]	Steam generator secondary level		Steam generator level indicator		AVI	AVI	AVI	FEC
	<u>Strategy Initiation</u>								
	Flow to steam generator [ADO ADO ADO ADO]	Auxiliary feedwater flow rate		Auxiliary feedwater flow indication		AVI	AVI	AVI	AVI
	<u>Strategy Effectiveness</u>								
	Increasing steam generator inventory [ADO ADO ADO NAV]	Steam generator secondary level		Steam generator level indication		AVI	AVI	AVI	FEC

TABLE D2.12. PREVENT CONTAINMENT FAILURE (C)--ISLOCA MECHANISM (C3B2)

	<u>Information Needs</u>	<u>Direct</u>	<u>Indirect</u>	<u>Available</u>	<u>Potential</u>	<u>Status in Phase</u>			
		<u>Information</u>	<u>Information</u>			<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>
		<u>Source</u>	<u>Source</u>						
Maintain integrity safety function (C1)	Containment leak rate	None		None					
			Containment pressure history	Contatinment pressure					
			Radiation level outside containment	Radiation monitoring system					
	Containment leak location	None		None					
			Radiation location outside containment	Radiation monitoring system					
	<u>Indicators</u>								
ISLOCA mechanism (C3B2)	Presence of containment bypass and fission product release [A10 A10 A10 A10]	None		None					
			Radiation outside containment	Radiation monitoring system		AVI	AVI	AVI	AVI
			RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC
			RCS inventory	Pressurizer level		AVI	FEC	FEC	FEC
				RVLMS		AVI	FEC	FEC	FEC

TABLE D2.12. (continued)

Information Needs	Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
					1	2	3	4
<u>Indicators (continued)</u>								
		Decreased RCS subcooled margin	RCS subcooling monitoring		AVI	FEC	FEC	FEC
		Containment pressure	Containment pressure		AVI	AVI	AVI	AVI
		Containment inventory	Sump level		AVI	AVI	AVI	FEC
<u>Precursors</u>								
Core damage status [AIO AIO AIO AIO]	None	RCS coolant activity	None Sampling system		AVI	AVI	AVI	AVI
		Core exit temperature history	Core exit thermocouples		AVI	FEC	FEC	FEC
		Reactor vessel inventory	RVLMS		AVO	FEC	FEC	FEC
<u>Selection Criteria</u>								
Isolate rupture strategy	Rupture location	None	None					
		Interfacing system conditions	System status indicators		AVI	AVI	AVI	AVI
		Visual surveillance of systems outside containment	Visual					

TABLE D2.12. (continued)

<u>Information Needs</u>		<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Initiation</u>									
Closure of isolation valve [AIO AIO AIO NAV]			Containment isolation valve status	Valve position indicator		AVI	AVI	AVI	FEC
<u>Strategy Effectiveness</u>									
Stabilized RCS conditions [ADO NAV NAV NAV]		RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
		RCS inventory		Pressurizer level RVLS		AVI	FEC	FEC	FEC
		RCS subcooling		RCS subcooled margin monitor		AVI	FEC	FEC	FEC
<u>Selection Criteria</u>									
Depressurize RCS strategy	Excess RCS pressure [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
<u>Strategy Initiation</u>									
RCS cooldown with steam generators [ADI AIO AIO NAV]		RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
			Steam generator secondary pressure	Pressure in steam generators		AVI	AVI	AVI	FEC
Open PORV [ADO ADO ADO NAV]		PORV position		PORV status indicator		AVI	AVI	AVI	FEC

TABLE D2.12. (continued)

<u>Information Needs</u>	<u>Direct</u> <u>Information</u> <u>Source</u>	<u>Indirect</u> <u>Information</u> <u>Source</u>	<u>Available</u> <u>Instruments</u>	<u>Potential</u> <u>Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Effectiveness</u>								
Increase in rate of RCS depressurization [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
<u>Selection Criteria</u>								
Flood break location strategy	Leak point can be flooded	Visual surveillance of systems outside containment		Visual				
<u>Strategy Initiation</u>								
Flow to break location [NAV NAV NAV NAV]	Flow in break flooding system			Flow indication	NI	NI	NI	NI
<u>Strategy Effectiveness</u>								
Decrease in magnitude of fission product release [ADO ADO ADO ADO]	Radiation outside containment		Radiation monitors		AVI	AVI	AVI	AVI

TABLE D2.13. PREVENT CONTAINMENT FAILURE (C)--STEAM EXPLOSION MISSILE MECHANISM (C3C1)

	<u>Information Needs</u>	Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain integrity safety function (C1)	Containment leak rate	None		None					
			Containment pressure history	Containment pressure					
			Radiation level outside containment	Radiation monitoring system					
			Containment leak location		None				
				Radiation location outside containment	Radiation monitoring system				
	<u>Indicators</u>								
Steam explosion missile mechanism (C3C1)	Penetration of containment by a missile [AIO AIO AIO AIO]	Containment visual observation		None					
			Containment pressure	Containment pressure		AVI	AVI	AVI	AVI

TABLE D2.13. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Precursors</u>								
	Rapid core relocation at low pressure [AIO NAV NAV NAV]	None	RCS pressure	Pressurizer pressure		AVI	FEC	FEC	FEC
	Core damage status [AIO AIO AIO AIO]		Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity	RCS sampling system		AVI	AVI	AVI	AVI
	Presence of water in lower plenum [NAV NAV NAV NAV]	Lower plenum water level		None	Lower plenum level sensor	NI	NI	NI	NI
	<u>Selection Criteria</u>								
Add barriers strategy	None-passive system								
	<u>Strategy Initiation</u>								
	None-passive system								

TABLE D2.13. (continued)

	<u>Information Needs</u>	<u>Direct</u>	<u>Indirect</u>	<u>Available</u>	<u>Potential</u>	<u>Status in Phase</u>			
		<u>Information</u>	<u>Information</u>			<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>
		<u>Source</u>	<u>Source</u>						
<u>Strategy Effectiveness</u>									
	Containment integrity [AIO AIO AIO AIO]	None		None		AVI	AVI	AVI	AVI
			Containment pressure	Containment pressure					
			Radiation outside containment	Radiation monitoring system		AVI	AVI	AVI	AVI
<u>Selection Criteria</u>									
Dry vessel strategy	Core damage status [AIO AIO AIO AIO]	None		None					
			Core exit temperature	Core Exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity	RCS sampling system		AVI	AVI	AVI	AVI
		Lower plenum inventory [NAV NAV NAV NAV]	Lower plenum water level		None	Lower plenum level sensor	NI	NI	NI

TABLE D2.13. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Strategy Initiation</u>								
	Lower plenum inventory [NAV NAV NAV NAV]	Lower plenum water level		None	Lower plenum level sensor	NI	NI	NI	NI
	<u>Strategy Effectiveness</u>								
	Containment integrity [AIO AIO AIO AIO]	None		None					
			Containment pressure	Containment pressure		AVI	AVI	AVI	AVI
	<u>Selection Criteria</u>								
RCS at high pressure strategy	RCS pressure [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
	Core damage status [AIO AIO AIO AIO]	None		None					
			Core exit temperature	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity	RCS sampling system		AVI	AVI	AVI	AVI

TABLE D2.13. (continued)

<u>Information Needs</u>	<u>Direct</u> <u>Information</u> <u>Source</u>	<u>Indirect</u> <u>Information</u> <u>Source</u>	<u>Available</u> <u>Instruments</u>	<u>Potential</u> <u>Instruments</u>	<u>Status in Phase</u>			
					<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Strategy Initiation</u>								
RCS pressure [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
<u>Strategy Effectiveness</u>								
RCS pressure [ADO NAV NAV NAV]	RCS pressure		Pressurizer pressure		AVI	FEC	FEC	FEC
Containment pressure [ADO ADO ADO ADO]	Containment pressure		Containment pressure		AVI	AVI	AVI	AVI

TABLE D2.14. PREVENT CONTAINMENT FAILURE (C)--HYDROGEN DETONATION MISSILE MECHANISM (C3C2)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain integrity safety function (C1)	Containment leak rate	None		None					
			Containment pressure history	Containment pressure					
			Radiation level outside containment	Radiation monitoring system					
	Containment leak location	None		None					
			Radiation location outside containment	Radiation monitoring system					
	<u>Indicators</u>								
Hydrogen detonation missile mechanism (C3A2)	Penetration of containment by a missile [A10 A10 A10 A10]	Containment visual observation		None					
			Containment pressure	Containment pressure		AVI	AVI	AVI	AVI
	<u>Precursors</u>								
	Increasing hydrogen gas concentration [ADO ADO ADO ADO]	Containment hydrogen concentration		Hydrogen monitoring system		AVI	AVI	AVI	AVI

TABLE D2.14. (continued)

	<u>Information Needs</u>	Direct	Indirect	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
		<u>Information Source</u>	<u>Information Source</u>			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Precursors (continued)</u>								
	Core damage status [AIO AIO AIO AIO]	None	Core exit temperature	None Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
			RCS coolant activity	RCS sampling system		AVI	AVI	AVI	AVI
	<u>Selection Criteria</u>								
Add barriers strategy	None-passive system								
	<u>Strategy Initiation</u>								
	None-passive system								
	<u>Strategy Effectiveness</u>								
	Containment integrity [AIO AIO AIO AIO]	None	Containment pressure	None Containment pressure		AVI	AVI	AVI	AVI
			Radiation outside containment	Radiation monitoring system		AVI	AVI	AVI	AVI

TABLE D2.14. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria</u>									
Prevent hydrogen explosion strategy	See Table A2.4 strategies.								
<u>Strategy Initiation</u>									
	See Table A2.4 strategies.								
<u>Strategy Effectiveness</u>									
	See Table A2.4 strategies.								

TABLE D3.1. MITIGATE FISSION PRODUCT RELEASE FROM CONTAINMENT (F)--AEROSOL DISPERSON MECHANISM (F1A1)

		Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
<u>Information Needs</u>						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain control of fission product inventory in containment atmosphere safety function (F1)	Presence of fission products in containment atmosphere [NAV NAV NAV NAV]	Containment radiation level		Radiation (CONT) monitoring system, noble gas monitoring system		FSS	FSS	FSS	FSS
<u>Indicators</u>									
Aerosol dispersion mechanism (F1A1)	Presence of aerosols in containment atmosphere [NAV NAV NAV NAV]	None	Containment radiation level	Radiation monitoring system		FSS	FSS	FSS	FSS
				Noble gas monitoring system		FSS	FSS	FSS	FSS
<u>Precursors</u>									
	Core damage status [AIO AIO AIO AIO]	None	RCS coolant activity	None Sampling system		AVI	AVI	AVI	AVI
			Core exit temperature history	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC

TABLE D3.1. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
	<u>Selection Criteria</u>								
Spray/ additives strategy	Fission products in containment	None		None					
	[NAV NAV NAV NAV]		Containment radiation level	Radiation monitoring system		FSS	FSS	FSS	FSS
	<u>Strategy Initiation</u>								
	Flow in spray system	Spray flow		Spray flow		AVI	AVI	AVI	AVI
	[ADO ADO ADO ADO]								
	<u>Strategy Effectiveness</u>								
	Decreased containment radiation level	None		None					
	[NAV NAV NAV NAV]		Containment radiation level	Radiation monitoring system		FSS	FSS	FSS	FSS
	<u>Selection Criteria</u>								
Filter system strategy	Fission product in containment atmosphere	None		None		FSS	FSS	FSS	FSS
			Containment radiation level	Radiation monitoring system					
	<u>Strategy Initiation</u>								
	Activation of filter fans	Filter fan system status		Fan status		AVI	AVI	AVI	FEC

TABLE D3.1. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Chemical reaction strategy	<u>Strategy Effectiveness</u>								
	Decreased containment radiation level [NAV NAV NAV NAV]		Containment radiation level	Radiation monitoring system		FSS	FSS	FSS	FSS
	<u>Selection Criteria</u>								
	None-passive system								
	<u>Strategy Initiation</u>								
	None-passive system								
	<u>Strategy Effectiveness</u>								
	Low containment radiation level [NAV NAV NAV NAV]	None	Containment radiation level	None Radiation monitoring system		FSS	FSS	FSS	FSS

TABLE D3.2. MITIGATE FISSION PRODUCT RELEASE FROM CONTAINMENT (F)--GASEOUS DISPERSION MECHANISM (F1A2)

	Information Needs	Direct	Indirect	Available	Potential	Status in Phase			
		Information	Information			1	2	3	4
		Source	Source	Instruments	Instruments				
Maintain control of fission product inventory in containment atmosphere safety function (F1)	Presence of fission products in containment atmosphere [NAV NAV NAV NAV]	Containment radiation level		Radiation (CONT) monitoring system, noble gas monitoring system		FSS	FSS	FSS	FSS
	<u>Indicators</u>								
Gaseous dispersion mechanism (F1A2)	Presence of fission product gases in containment atmosphere [NAV NAV NAV NAV]	None	Containment radiation levels	None Radiation monitoring system		FSS	FSS	FSS	FSS
				Noble gas monitoring system		FSS	FSS	FSS	FSS
	<u>Precursors</u>								
	Core damage status [AIO AIO AIO AIO]	None	RCS coolant activity	None Sampling system		AVI	AVI	AVI	AVI
			Core exit temperature history	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC

TABLE D3.2. (continued)

	<u>Information Needs</u>	Direct	Indirect	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
		<u>Information Source</u>	<u>Information Source</u>			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria</u>									
Chemical reactions strategy	Presence of fission product gases in containment atmosphere	None		None					
	[NAV NAV NAV NAV]		Containment radiation levels	Radiation monitoring system		FSS	FSS	FSS	FSS
<u>Strategy Initiation</u>									
	Containment circulation system operating	Containment circulation [ADO ADO ADO ADO]		System (fan cooling) status system status		AVI	AVI	AVI	AVI
<u>Strategy Effectiveness</u>									
	Reduced concentration of fission product gases in containment atmosphere	None		None					
	[NAV NAV NAV NAV]		Containment radiation level	Radiation monitoring		FSS	FSS	FSS	FSS

TABLE D3.2. (continued)

	<u>Information Needs</u>	<u>Direct</u>	<u>Indirect</u>	<u>Available</u>	<u>Potential</u>	<u>Status in Phase</u>			
		<u>Information</u>	<u>Information</u>			<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>
<u>Selection Criteria</u>									
Cryogenic system strategy	Presence of fission product gases in containment atmosphere		Containment radiation levels	Radiation monitoring system		FSS	FSS	FSS	FSS
	[NAV NAV NAV NAV]	Containment noble gas concentration		Noble gas monitoring system		FSS	FSS	FSS	FSS
<u>Strategy Initiation</u>									
	Cryogenic system operating [NAV NAV NAV NAV]	Cryogenic system status			System status	NI	NI	NI	NI
<u>Strategy effectiveness</u>									
	Reduced concentration of fission product gases in containment atmosphere		Containment radiation	Radiation monitoring system		FSS	FSS	FSS	FSS
	[NAV NAV NAV NAV]	Containment noble gas concentration		Noble gas monitoring system		FSS	FSS	FSS	FSS

TABLE D3.3. MITIGATE FISSION PRODUCT RELEASE (F)--pH TOO-LOW MECHANISM (F2A1)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain control of fission product release from containment water safety function (F2)	Presence of fission products in containment water [NAV NAV NAV NAV]	Containment sump water chemistry		Sump water sampling system		FSS	FSS	FSS	FSS
			Containment radiation level	Radiation monitoring system		FSS	FSS	FSS	FSS
	<u>Indicators</u>								
pH too-low mechanism (F2A1)	Containment water pH presence of iodine [NAV NAV NAV NAV]	Containment sump water chemistry		Accident sampling system		FSS	FSS	FSS	FSS
	<u>Precursors</u>								
	Core damage [AIO AIO AIO AIO]	None		None					
			RCS coolant activity	Sampling system		AVI	AVI	AVI	AVI
			Core exit temperature history	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC

TABLE D3.3. (continued)

	<u>Information Needs</u>	Direct	Indirect	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
		<u>Information Source</u>	<u>Information Source</u>			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria</u>									
Add base strategy	Amount of contaminated water [AIO AIO AIO NAV]	None		None					
			Containment sump inventory	Sump level indicator		AVI	AVI	AVI	FEC
	Availability of basic solution [NAV NAV NAV NAV]	None		None					
				Supply of chemicals for base solution		Tank levels	NI	NI	NI
<u>Strategy Initiation</u>									
	Flow of basic solution [NAV NAV NAV NAV]	Flow in system for adding base to containment water			Flow indicator	NI	NI	NI	NI
<u>Strategy Effectiveness</u>									
	Increase in containment water pH [NAV NAV NAV NAV]	Containment sump water chemistry		Accident sampling system		FSS	FSS	FSS	FSS

TABLE D3.3. (continued)

	<u>Information Needs</u>	<u>Direct Information Source</u>	<u>Indirect Information Source</u>	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
						<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Selection Criteria</u>									
Dilution strategy	Amount of contaminated water [AIO AIO AIO NAV]	None		None					
			Containment sump inventory	Sump level indicator		AVI	AVI	AVI	FEC
	Inventory of dilution liquid [NAV NAV NAV NAV]	Dilution system tank level			Level indicator	NI	NI	NI	NI
<u>Strategy Initiation</u>									
	Flow of dilution liquid to containment waste [NAV NAV NAV NAV]	Flow in dilution system			Flow indicator	NI	NI	NI	NI
<u>Strategy Effectiveness</u>									
	Increase in containment water pH [NAV NAV NAV NAV]	Containment sump water chemistry		Accident sampling system		FSS	FSS	FSS	FSS

TABLE D3.4. MITIGATE FISSION PRODUCT RELEASE FROM CONTAINMENT (F)--RADIOLYSIS MECHANISM (F23A2)

	<u>Information Needs</u>	Direct	Indirect	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
		<u>Information Source</u>	<u>Information Source</u>			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Maintain control of fission product release from containment water safety function (F23)	Presence of fission products in containment water [NAV NAV NAV NAV]	Sump water radiation level		Sump water sampling system		FSS	FSS	FSS	FSS
	<u>Indicators</u>								
Radiolysis mechanism (F23A2)	Presence of radiolytic products	None		None					
			Containment atmosphere sampling	Sampling system		AVI	AVI	AVI	FEC
	<u>Precursors</u>								
	Core damage status [AIO AIO AIO AIO]	None		None					
			RCS coolant activity	Sampling system		AVI	AVI	AVI	AVI
			Core exit temperature history	Core exit thermocouples		AVI	FEC	FEC	FEC
			Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC

TABLE D3.4. (continued)

	<u>Information Needs</u>	<u>Direct</u>	<u>Indirect</u>	<u>Available</u>	<u>Potential</u>	<u>Status in Phase</u>			
		<u>Information</u>	<u>Information</u>			<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>
		<u>Source</u>	<u>Source</u>						
<u>Precursors (continued)</u>									
	Water available for radiolysis [ADO NAV NAV NAV]	None		None					
			Reactor vessel level	RVLMS		AVI	FEC	FEC	FEC
			Cavity inventory	None		NI	NI	NI	NI
<u>Selection Criteria</u>									
Dilution strategy	Availability of dilution water [NAV NAV NAV NAV]	Dilution system tank level			Tank level indicators	NI	NI	NI	NI
<u>Strategy Initiation</u>									
	Flow of water to damaged core [NAV NAV NAV NAV]	Injection pump flow			Flow indicator	NI	NI	NI	NI
<u>Strategy Effectiveness</u>									
	Water level above core [ADO NAV NAV NAV]	Reactor vessel inventory		RVLMS		AVI	FEC	FEC	FEC

TABLE D3.5. MITIGATE FISSION PRODUCT RELEASE FROM CONTAINMENT (F)--EXCESSIVE WATER TEMPERATURE MECHANISM (F2A3)

	Information Needs	Direct Information Source	Indirect Information Source	Available Instruments	Potential Instruments	Status in Phase			
						1	2	3	4
Maintain control of fission product release from containment water safety function (F2)	Presence of fission products in containment water [NAV NAV NAV NAV]	Sump water radiation level		Sump water sampling system		FSS	FSS	FSS	FSS
	<u>Indicators</u>								
Excessive water temperature mechanism (F2A3)	Sump water temperature	Sump water temperature		Sump water temperature		NI	NI	NI	NI
	<u>Precursors</u>								
	Inadequate heat removal from sump water [AIO AIO AIO AIO]	None		None					
			Sump water temperature	Sump water temperature indicators		NI	NI	NI	NI
			Sump water cooling heat exchanger outlet temperature	Temperature indicators		AVI	AVI	AVI	AVI

TABLE D3.5. (continued)

<u>Information Needs</u>	Direct	Indirect	<u>Available Instruments</u>	<u>Potential Instruments</u>	<u>Status in Phase</u>			
	<u>Information Source</u>	<u>Information Source</u>			<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Precursors (continued)</u>								
Core damage status [AIO AIO AIO AIO]	None		None					
		RCS coolant activity	Sampling system		AVI	AVI	AVI	AVI
		Core exit temperature history	Core exit thermocouples		AVI	FEC	FEC	FEC
		Reactor vessel inventory	RVLMS		AVI	FEC	FEC	FEC
<u>Selection Criteria</u>								
Cooling system strategy	Sump water temperature	Sump water temperature	Sump Water temperature indicators					
	Operation of containment heat removal systems [ADO ADO ADO ADO]	Status of containment heat removal systems	Temperature and flow indicators		AVI	AVI	AVI	AVI
<u>Strategy Initiation</u>								
	Operation of sump water cooling system [ADO ADO ADO ADO]	Status of sump water cooling system	Temperature and flow indicators		AVI	AVI	AVI	AVI

TABLE D3.5. (continued)

	<u>Information Needs</u>	<u>Direct</u>	<u>Indirect</u>	<u>Available</u>	<u>Potential</u>	<u>Status in Phase</u>			
		<u>Information</u>	<u>Information</u>			<u>Instruments</u>	<u>Instruments</u>	<u>1</u>	<u>2</u>
		<u>Source</u>	<u>Source</u>						
<u>Strategy Effectiveness</u>									
	Reduction in sump water temperature	Sump water temperature		Sump water temperature indications		NI	NI	NI	NI
			Heat exchanger outlet temperature	Outlet temperature indicator		AVI	AVI	AVI	AVI
<u>Selection Criteria</u>									
Add cooler water strategy	Sump water temperature	Sump water temperature		Sump water temperature indicators		NI	NI	NI	NI
	Inventory of water to fill sump [NAV NAV NAV NAV]	Sump fill system tank level			Tank level indicators	NI	NI	NI	NI
<u>Strategy Initiation</u>									
	Flow of water to sump [NAV NAV NAV NAV]	Flow rate in sump fill system			Flow indicator	NI	NI	NI	NI
	Increase in containment sump inventory [ADO ADO ADO NAV]	Containment sump inventory		Sump level indicator		AVI	AVI	AVI	FEC
<u>Strategy Effectiveness</u>									
	Reduction in containment water temperature	Sump water temperature		Sump water temperature indicator		NI	NI	NI	NI

APPENDIX E
POTENTIAL MEASUREMENTS TO
FULFILL INFORMATION NEEDS

APPENDIX E

POTENTIAL MEASUREMENTS TO FULFILL INFORMATION NEEDS

The tables contained in Appendix E contain the potential measurements identified to fulfill information needs for a plant represented by a Combustion Engineering 2700 MW(t) plant such as Calvert Cliffs Units 1 and 2 or Millstone Unit 2. Table E1 lists proposed or potential measurements that could be used to supply information needs in cases where measurements are not currently available. Table E2 lists measurements that would be required for existing systems that could be used as part of a strategy for accident management. The columns that are contained in this table are as follows:

Potential Measurements Identified: the measurements identified from Tables A1 through A3 that may be required for existing systems to be used for particular accident management strategies

Information Need: the information needs that would be provided by the potential measurement

Potential Severe Accident Measurement Range: the range of conditions the instrument might experience during a severe accident

Location of the Instrument: the general location of the instrument sensor.

Table E2 lists those measurements that could be used to monitor proposed systems that would be needed for new strategies for accident management. This table has columns to list the potential measurement, the information needs it would provide, the measurement range it would need to cover, and the location of the sensor. The last two columns were completed during the analysis of a specific severe accident presented in Section 4 of the main report.

TABLE E1. POTENTIAL MEASUREMENTS TO FULFILL INFORMATION NEEDS

Potential Measurements Identified	Information Need	Potential Severe Accident Measurement Range	Location of Information
Fuel rod internal pressure	Fuel rod geometry Fuel rod cladding condition	0 to maximum rupture pressure (~2000 psi)	Reactor
Cladding temperature	Cladding temperature Core temperature Core material temperature and geometry Fuel rod cladding condition	0 to 3500°F	Reactor
Fuel location	Core material geometry	To be determined (TBD)	TBD
Fuel temperature	Core material temperature and geometry Cladding temperature	0 to 5000°F	Reactor
Vessel and lower head visual observation	Vessel integrity Approach to vessel failure Lower head temperature		
Vessel wall temperature	Vessel integrity Approach to vessel failure Vessel wall temperature	0°F to melting point of lower head	Containment (cavity)
Basemat temperature	Amount of concrete ablated	0°F to melting point of concrete/ basemat material	Containment (cavity)
Containment visual observation	Containment penetration by missile Presence of missile		

TABLE E1. (continued)

Potential Measurements Identified	Information Need	Potential Severe Accident Measurement Range	Location of Information
Cavity inventory	Cavity inventory Lower head failure and fission product release Water available for radiolysis	Cavity level 0 to 100%	Containment (cavity)
Lower plenum water level	Presence of water in lower plenum (Precursor to steam explosion) Lower plenum inventory Potential for steam explosion	Lower head level 0 to 100%	Reactor vessel
Quench tank samples	Presence of fission products in relief valve discharge flow Presence of fission products in quench tank Fission product transport from RCS	TBD	Containment
Flow in quench tank fill system	Flow in quench tank	0 to 110% design flow	Containment
Lower head temperature	Lower head failure and fission product release Lower head temperature	0°F to melting point of lower head	Containment (cavity)
Containment penetration temperature	Containment penetration integrity	TBD	Containment

TABLE E2. MEASUREMENTS FOR SYSTEMS NEEDED FOR POTENTIAL STRATEGIES

Potential Measurements Identified	Information Need	Potential Severe Accident Measurement Range	Location of Information
Cavity flooding system tank inventory	Inventory available to flood cavity Flooding initiation	TBD	TBD
Cavity flooding system flow rate	Flooding initiation Water flow to cavity	TBD	TBD
Cavity drain system flow rate	Water flow from cavity	TBD	TBD
Vent system flow rate	Vent system flow initiation	TBD	TBD
Containment leak location	Leak point can be located and flooded	TBD	TBD
Flow in leak flooding system	Flow to leak location	TBD	TBD
Interfacing system conditions	Rupture location (V-sequence)	TBD	TBD
Visual surveillance of systems outside containment	Rupture location (V-sequence) Leak point can be flooded	TBD	TBD
Flow in break flooding system	Flow to break location outside containment (V-sequence)	TBD	TBD
Cryogenic system status	Cryogenic system operating	TBD	TBD
Filter fan system status	Activation of filter fans	TBD	TBD

TABLE E2. (continued)

Potential Measurements Identified	Information Need	Potential Severe Accident Measurement Range	Location of Information
Supply of chemicals for base solution	Availability of basic solution	TBD	TBD
Flow in system for adding base to containment water	Initiation of add base strategy	TBD	TBD
	Flow of basic solution		
Dilution system tank level	Inventory of dilution liquid	TBD	TBD
	Availability of dilution water		
Flow in dilution system	Flow of dilution liquid to containment water	TBD	TBD
Containment atmosphere sampling	Presence of radiolytic products	TBD	TBD
Flow rate in sump fill system	Flow of water to sump	TBD	TBD
Sump fill system tank level	Inventory of water to fill sump	See containment sump level	

APPENDIX F

ACCIDENT MANAGEMENT INFORMATION ASSESSMENT

APPENDIX F

ACCIDENT MANAGEMENT INFORMATION ASSESSMENT

The tables contained in Appendix F describe the information needs and instruments available for each of the challenges and mechanisms under each safety function, starting with *Inadequate Secondary Heat Removal* for the *Maintain RCS Heat Removal* safety function. The strategies that may be available to

combat a challenging mechanism are addressed immediately after addressing the individual mechanisms. The safety objective tree was reviewed from top-to-bottom and left-to-right for this assessment of information needs and the results are tabulated accordingly in Tables F1 through F8.

TABLE F1. ACCIDENT MANAGEMENT INFORMATION ASSESSMENT

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Core Dispersal from Vessel
 Safety Function Maintain Core Boundary

	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 1 Blowdown</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>
<u>Status</u> of the safety function Maintain Core Heat Removal	Core heat removal	None	Core exit thermocouples (CETs), RVLMS	RVLMS will indicate approach to core uncover	No challenge to SF;	CETs & RVLMS instruments fail during Phase 2.	No information available. Hot & cold leg RTDs have range limitations.
<u>Challenging Mechanism</u> -- Inadequate RCS Inventory	RCS Inventory	None	Pressurizer level RVLMS, CETs, hot and cold leg RTDs	Need current value, trend, and history (cv, t, h) from RVLMS.	Instrument readings confirm approach to core uncover.	CETs & RVLMS fail	No information available. Hot & cold leg RTDs have range limitations
<u>Strategy</u> -- Injection into RCS (HPIS & LPIS) (Assumed to fail)	RCS pressure	Pressurizer pressure		Need cv, t, h.	Pressurizer pressure	These instruments fail during Phase 2.	
	RCS inventory	None	Pressurizer level Subcooling monitor CETs, RVLMS	Need to relate readings over cv, t, h.	Pressurizer level Subcooling monitor, CETs indicate injection.	Indication same as Phase 1	No information available to confirm injection
	Injection water availability	Tank levels		SIT level not qualified for harsh environment	Tank levels	Tank levels	Tank levels

TABLE F1. (continued)

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Core Dispersal from Vessel
 Safety Function Maintain Core Boundary

	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 1 Blowdown</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>
<u>Challenging Mechanism--</u> Inadequate RCS Inventory (cont'd)							
<u>Strategy--RCS</u> inventory sources	Inventory availability	Tank levels		Information is available; SIT level is not qualified	Available	Available	Available
	Pumping Capability	Electric Power Capabilities, Steam availability			Available	Available	Available
	Alignment capability	Valve alignment indicators			Available	Available	Available

TABLE F1. (continued)

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Core Dispersal from Vessel
 Safety Function Maintain Core Boundary

	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 1 Blowdown</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>
<u>Challenging Mechanism--</u>							
Change in Core Geometry	Core material Temperature and Geometry	None	CETs, SPNDs, SRNIs, Coolant activity	SRNIs will fail since not qualified for harsh environs; SRNIs failed due to environment in Phase 2.	No challenge present	SPNDs & CETs will indicate high core temperature prior to failure; SRNIs will fail.	No information available
<u>Strategy--RCS Injection methods and RCS Inventory Sources (same as above)</u>							
<u>Strategy--RCS Pump Restart</u>	RCS flow status	RCS flow rate, RCS pump speed, RCS pump differential pressure, RCS pump motor current		Information available; however, restart of pump during voided conditions could promote damage.	No challenge	Information available	Information available
	Fuel rod clad temperature	None	CETs, SPNDs		No challenge	SPNDs and CETs will indicate high core temp. prior to failure	No information available

TABLE F2. ACCIDENT MANAGEMENT INFORMATION ASSESSMENT

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Core Dispersal from Vessel
 Safety Function Maintain Vessel Boundary

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Status</u> of the safety function Maintain Vessel Boundary	Vessel integrity	None	Pressurizer pressure	Need cv, t, h.	Pressurizer pressure (fails in later stage of Phase 2).		
<u>Challenging Mechanism</u> -- Overtemperature coolable relocation	Core relocation status	None	SRNIs, Pressurizer pressure, Hot & cold leg	Need cv, t, h.	These instruments fail in later stage of Phase 2.		
	Core damage status	None	RTDs, CETs, RVLMS, RCS sampling system		CET & RVLMS instr. fail in Phase 2. RCS sampling system	RCS sampling system	RCS sampling system
<u>Strategy</u> -- Injection into RCS (HPIS and LPIS failed)	RCS pressure RCS inventory	Pzr. pressure None	Pressurizer level, RVLMS	Need cv, t, h.	Instruments fail during Phase 2.		
	Injection water availability	Tank levels sump levels			Tank levels Sump level (fails during Phase 2).	Tank levels	Tank levels

TABLE F2. (continued)

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Core Dispersal from Vessel
 Safety Function Maintain Vessel Boundary

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
	Injection pump flow	Injection pump flow rate			Injection pump flow rate	Injection pump flow rate	Injection pump flow rate
<u>Strategy</u> --RCS heat removal using SGs	SG secondary pressure	SG pressure			SG pressure	SG pressure	
	FW flow	FW flow,			FW flow	FW flow	FW flow
	RCS pressure	Pzr. pressure,		Need cv, t, h and and relation between readings to verify national circ or reflux.	Instruments fail during Phase 2.		
	RCS temperature	Cold and hot leg RTD, Subcooling monitor, CETs					
<u>Strategy</u> --RCS heat removal using PORVs	RCS pressure	Pzr. pressure		Continued use of PORV flow for RCS heat removal requires RCS injection (see above) and precautions against toxic acid precipitation.	Instruments fail during Phase 2.		
	RCS inventory	None					
	PORV flow	Pressurizer level RVLMS,					
		Pzr. pressure PORV discharge pipe temperature, noise				PORV discharge pipe noise	PORV discharge pipe temperature noise

The strategy of using RCS injection methods may require depressurization of the RCS to allow lower pressure injection systems to operate and may involve use of steam generator atmospheric dump valve, bypass, or RCS PORVs. These strategies are included in the inadequate primary and secondary heat removal challenges to the Maintain RCS Heat Removal strategy and are included here since they may be necessary to provide alternate RCS injection methods.

TABLE F2. (continued)

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Core Dispersal from Vessel
 Safety Function Maintain Vessel Boundary

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Challenging Mechanism</u> -- Noncoolable relocation	Core relocation status	None	SRNIs, Pzr. pressure Hot & cold leg RTDs				
	Core damage status	None	CETs, RVLMS, RCS sampling system		RCS sampling system	RCS sampling system	RCS sampling system
<u>Strategy</u> --Flood cavity				No capability for this strategy is installed.			

TABLE F3. ACCIDENT MANAGEMENT INFORMATION ASSESSMENT

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Containment Failure
 Safety Function Maintain Pressure Control

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Status</u> of safety function	Containment pressure	Containment pressure		Need cv, t, h.	Containment pressure	Containment pressure	Containment pressure
<u>Challenging Mechanism</u> -- Insufficient energy removal	Energy added to the containment atmosphere	None	Containment pressure Containment pressure atmosphere temperature	Need cv, t, h and parameters are related.	Containment pressure Containment atmosphere temperature	Containment pressure Containment atmosphere temperature	Containment pressure
	RCS integrity (LOCA information)	None	Pzr. pressure Pressurizer level RVLMS Subcooling monitor	Need cv, t, h and parameters are related.	Instruments fail during Phase 2.		
	SG secondary integrity	None	SG pressure SG level Steam flow/ feed flow mismatch	Need cv, t, h and parameters are related.	Need cv, t, h and parameters are related.	Need cv, t, h and parameters are related.	Need cv, t, h and parameters are related.

TABLE F3. (continued)

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Containment Failure
 Safety Function Maintain Pressure Control

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Strategy</u> --Fan coolers	Fan cooling system status	System status indicators		Includes heat exchanger effectiveness	System status indicators	System status indicators	System status indicators
<u>Strategy</u> --Spray system	Spray water availability Spray flow rate	Tank level Sump level Spray flow rate Pump discharge pressure Pump motor current			Tank level Sump level Spray flow rate Pump discharge pressure Pump motor current	Tank level Sump level Spray flow rate Pump discharge pressure Pump motor current	Tank level Sump level Spray flow rate Pump discharge pressure Pump motor current
<u>Strategy</u> --Containment venting	Containment overpressure threat	Containment pressure		Need cv, t, h	Need cv, t, h	Need cv, t, h	Need cv, t, h
		Containment temperature		Need cv, t, h	Need cv, t, h	Need cv, t, h	
	Radioactive content of containment atmosphere	Containment radiation monitors					

TABLE F3. (continued)

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Containment Failure
 Safety Function Maintain Pressure Control

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Challenging Mechanism</u> -- Noncondensible gas buildup	Concentrations of noncondensibles	Hydrogen monitors Noble gas monitors			Hydrogen monitors	Hydrogen monitors	Hydrogen monitors
	Hydrogen and noble gas release from RCS	None	Pzr. pressure, PZR level, RVLMS CETs RCS sampling system		RCS sampling system	RCS sampling system	RCS sampling system
<u>Strategy</u> -- Hydrogen recombiners or igniters	Status indicators for hydrogen recombiners or igniters	Status indicators for hydrogen recombiners or igniters			Status indicators for hydrogen recombiners or igniters	Status indicators for hydrogen recombiners or igniters	Status indicators for hydrogen recombiners or igniters
<u>Strategy</u> -- Containment venting	Information needs and instruments are same as containment venting strategy for the Insufficient Energy Removal challenging mechanism.						

TABLE F3. (continued)

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Containment Failure
 Safety Function Maintain Pressure Control

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Challenging Mechanism</u> -- Construable gas detonation	Information needs and instruments are similar to those for the Noncondensable Gas Buildup challenging mechanism.						
<u>Challenging Mechanism</u> -- Steam explosion	Since no flooding system for the RV cavity exists on this plant, this mechanism may not be credible.						
<u>Challenging Mechanism</u> -- Energy addition at reactor vessel failure	See "Core Dispersal from Vessel--Maintain Vessel Boundary" safety function for information needs and instruments to anticipate vessel failure. See "Prevent Containment Failure--Maintain Pressure Control" for strategies to reduce containment pressure prior to vessel failure.						

TABLE F4. ACCIDENT MANAGEMENT INFORMATION ASSESSMENT

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Containment Failure
 Safety Function Maintain Temperature Control

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Status</u> of safety function	Containment pressure boundary temperature	None	Containment atmosphere temperature	Need cv, t, h	Containment atmosphere temperature	Containment atmosphere temperature	
<u>Challenging Mechanism</u> -- Temperature-induced degradation of containment penetration	Containment penetration integrity	None	Containment atmosphere temperature	Need cv, t, h	Need cv, t, h	Need cv, t, h	
<u>Strategy</u> -- Fan cooler systems	Information needs and instruments for these two strategies are similar to those for the Insufficient Energy Removal challenge to the Maintain Pressure Control safety function.						
<u>Strategy</u> -- Spray systems							
<u>Status</u> of Safety function	Containment pressure boundary temperature	None	Containment atmosphere temperature	Need cv, t, h	Containment atmosphere temperature	Containment atmosphere temperature	
<u>Challenging Mechanism</u> -- Temperature of containment penetration	Containment penetration integrity	None	Containment atmosphere temperature	Need cv, t, h	Need cv, t, h	Need cv, t, h	

TABLE F4. (continued)

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Containment Failure
 Safety Function Maintain Temperature Control

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Strategy--</u> Fan cooler systems	Information needs and instruments for these two strategies are similar to those for the Insufficient Energy Removal challenge to the Maintain Pressure Control safety function.						
<u>Strategy--</u> Spray system							
<u>Challenging Mechanism--</u> Basemat melt-through by core-concrete interaction	Degree of concrete attack	None	Containment atmosphere sampling	Functionality of this system is uncertain.	Functionality of this system is uncertain.	Functionality of this system is uncertain.	Functionality of this system is uncertain.
	Vessel integrity status	None	None				
	Core damage status	None	CETs RVLMS RCS sampling system Containment atmosphere sampling	Functionality of this system is uncertain.	Instruments fail during Phase 2. RCS sampling system Functionality of this system is uncertain.	RCS sampling system Functionality of this system is uncertain.	RCS sampling system Functionality of this system is uncertain.
<u>Strategies--</u> Flood cavity Add barriers	Not installed on this plant.						

TABLE F5. ACCIDENT MANAGEMENT INFORMATION ASSESSMENT

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Containment Failure
 Safety Function Maintain Integrity

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Status</u> of the safety function	Occurrence of a missile	None	None				
<u>Challenging Mechanism</u> -- Steam explosion missile	Containment integrity	None	Containment pressure		Containment pressure	Containment pressure	Containment pressure
	Precursors: Rapid core relocation	None	Pzr. pressure		These instruments fail during Phase 2		
	Core damage	None	CETs, SRNIs, RVLMS, RCS sampling		RCS sampling	RCS sampling	RCS sampling
<u>Strategies</u> Dry vessel	Indirect instrument readings above provide the only information available that may be applicable to these strategies.						
RCS at high pressure							

TABLE F5. (continued)

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Containment Failure
 Safety Function Maintain Integrity

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Challenging Mechanism--</u>							
Hydrogen detonation missile	Hydrogen gas concentration ($H_2:O_2:H_2O$ values)	Hydrogen monitoring	system		Hydrogen monitoring	Hydrogen monitoring system	Hydrogen monitoring system system
<u>Strategy--</u>							
Prevent hydrogen explosion	Similar to strategies for the Combustible Gas Detonation challenge to the Maintain Pressure Control safety function.						

TABLE F6. ACCIDENT MANAGEMENT INFORMATION ASSESSMENT

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Mitigate Fission Product Release from Containment
 Safety Function Maintain Control of FP Inventory in Containment Atmosphere

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Status</u> of safety function	FP inventory in containment atmosphere	Containment radiation monitor		Failed, not qualified			
			Site radiation monitor		Inferences are possible as to the presence of FPs and a possible order of magnitude.		
			LOCA and core damage history and RCS sampling		Inferences are possible as to the presence of FPs of FPs and a possible order of magnitude.		
<u>Challenging Mechanism--</u> Aerosol dispersion	Identification of aerosols in atmosphere	None	None				
<u>Strategy--</u> Containment spray	Flow in spray system	Spray flow			Spray flow	Spray flow	Spray flow
				Information on effectiveness of spray not available.			
<u>Challenging Mechanism--</u> Gaseous dispersion	Presence of FP gases	None					
				Inferences are possible as to the presence of FP gases, but no strategies are available.			

TABLE F7. ACCIDENT MANAGEMENT INFORMATION ASSESSMENT

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Mitigate Fission Product Release from Containment
 Safety Function Maintain Control of FP Release from Containment Water

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Status</u> of safety function	Presence of FP in containment water	None	Inferences as to FP presence are possible, but no quantifiable				
<u>Challenging Mechanism</u> -- pH too low	Sump water chemistry	None	None	Failed, not qualified			
Without the information shown above, the possible strategies are not viable.							
<u>Challenging Mechanism</u> -- High temperature of sump water	Sump temperature	Sump temperature		No instruments available.			
<u>Strategy</u> -- Operation of instru- containment heat removal systems	Status of sump water cooling systems	Status instruments for sump water cooling			Status instru- ments for sump water cooling	Status instru- ments for sump water cooling	Status instru- Status ments for sump water cooling

TABLE F8. ACCIDENT MANAGEMENT INFORMATION ASSESSMENT

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Containment Failure
 Safety Function Maintain Integrity

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Status</u> of safety function	Quantity and source of FP being dispersed from RCS	None	Containment and monitors RCS sampling system CETs, RVLMS	Not available due to RCS radiation	LOOP RCS sampling system Fails during Phase 2 Fails during Phase 2	RCS sampling system	RCS sampling system
<u>Challenging Mechanism</u> --PORV or SRV	Presence of FP in discharge flow	None	Discharge pipe temperature, Discharge pipe acoustic monitor, Quench tank level, temperature, and pressure	Not available, not qualified	Fails during Phase 2 Discharge pipe acoustic monitor	Discharge pipe acoustic monitor	Discharge pipe acoustic monitor
<u>Strategy</u> --Quench tank scrubbing				Not available due to loss of tank instruments on LOOP.			
<u>Strategy</u> --Auxiliary spray to pressurizer				Availability uncertain due to LOOP and loss of HPIS.			

TABLE F8. (continued)

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Containment Failure
 Safety Function Maintain Integrity

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Challenging Mechanism--</u>							
RCS boundary failure (ISLOCA)	Existence of ISLOCA	None	Containment pressure		Containment pressure	Containment pressure	Containment pressure
			Containment temperature and sump levels		Containment temperature and sump levels	Containment temperature and sump levels	Containment temperature and sump levels
			Pzr. pressure, temperature and subcooling and PZR level		Fails during phase 2		
<u>Challenging Mechanism--</u>							
Failure to Isolate	Presence of CIS failure and FP release	None	CIS valve position		CIS valve position	CIS valve position	CIS valve position
			Radiation outside containment		Radiation outside containment	Radiation outside containment	Radiation outside containment
<u>Strategy--</u>							
Reisolate CIS	CIS valve position	CIS valve position			CIS valve position	CIS valve position	CIS valve position

TABLE F8. (continued)

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Containment Failure
 Safety Function Maintain Integrity

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Challenging Mechanism</u> -- Failure after Isolation	Presence of CIS failure and FP release	None	CIS valve position Radiation outside containment		CIS valve position Radiation outside containment	CIS valve position Radiation outside containment	CIS valve position Radiation outside containment
<u>Strategy</u> -- Reisolate CIS	CIS valve position	CIS valve position			CIS valve position	CIS valve position	CIS valve position
<u>Challenging Mechanism</u> -- SGTR	Presence of FP in steam line Radiation ex-containment	Steam line radiation monitor Site radiation monitoring system			Steam line radiation monitor Site radiation monitoring system	Steam line radiation monitor Site radiation monitoring system	Steam line radiation monitor Site radiation monitoring system
<u>Strategy</u> -- Depressurize RCS below SG secondary	See the Depressurize RCS strategy for DCH under the Maintain Pressure Control safety function.						
<u>Strategy</u> -- Flood SG secondary	SG water level control	SG level auxiliary, FW flow			SG level auxiliary, FW flow	SG level auxiliary, FW flow	auxiliary, FW flow

TABLE F8. (continued)

Scenario SBLOCA/LOOP Plant _____
 Safety Objective Prevent Containment Failure
 Safety Function Maintain Integrity

<u>Element</u>	<u>Information Needs</u>	<u>Direct Instrument</u>	<u>Indirect Instrument</u>	<u>Comment</u>	<u>Phase 2 Core Heatup</u>	<u>Phase 3 Lower Head Heatup</u>	<u>Phase 4 Containment Heatup</u>
<u>Challenging Mechanism--</u> LOCA with containment bypass	Presence of LOCA with bypass and FP release	None	Radiation outside containment Pzr. pressure, temperature, subcooling, RVLMS, and Pzr. level		Radiation outside containment Fails during Phase 2	Radiation outside containment	Radiation outside containment
Instruments are sufficient to determine that a challenge does not exist and that strategies are not required.							