



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUN 26 1979

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MEMORANDUM FOR: S. H. Hanauer, Director
Unresolved Safety Issues Program

FROM: Goutam Bagchi, Chief
Structural Engineering Research Branch

THRU: L. C. Shao, Assistant Director
for General Reactor Safety Research *L. Shao*

SUBJECT: TASK ACTION PLAN (TAP) A-40, SEISMIC DESIGN CRITERIA -
SHORT TERM INFORMATION FOR ACRS

Enclosed is the relevant information you requested in your memorandum dated June 15, 1979.

Also enclosed is a copy of a table summarizing RES support of Unresolved Safety Issues in FY1979 and FY1980.

Goutam Bagchi, Chief
Structural Engineering Research Branch
Division of Reactor Safety Research

Enclosures: as stated

cc: T. E. Murley, RSR
L. C. Shao, RSR
J. E. Richardson, RSR
J. Harbour, RSR
C. W. Burger, RSR

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1. Following is a list of Industry/NRC studies:

Nelson, T. A., Murray, R. C., "Elastic-Plastic Seismic Analysis of Power Plant Braced Frames," Dec. 4, 1978.

Bumpus, S., Smith, P. S., "The Role of the Operating Basis Earthquake in Controlling Design," May 21, 1979.

URS/John A. Blume, & Associates, Engineers, "Nonlinear Structural Dynamic Analysis Procedures for Category I Structures," Sept. 1978.

Smith, P. D., "Structural Damping," Part IV, UCID-18111.

Maslenikov, O. R., Smith, P. D., "Soil-Structure Interaction at the Humboldt Bay Power Plant," Part V, UCID-18105.

Smith, P. D., Bumpus, S., Maslenikov, O. R., "Response to Three Input Components," Part VI, UCID-17959.

Smith, P. D., Bumpus, S., Maslenikov, O. R., "Broadening of Floor Response Spectra," Part VII, UCID-18104.

Bumpus, S., "Structural and Mechanical Resistance," Part VIII, UCID-17965.

Bumpus, S., "Nonlinear Structural Response," Part IX, UCID-18100.

Maslenikov, O. R., Smith, P. D., "Calculation of Subsystem Response," Part X, UCID-18110.

Nelson, T. A., "Seismic Analysis Methods for the Systematic Evaluation Program," UCRL-52528, July 1978.

Berkowitz, L., "Seismic Analysis of Primary Piping Systems for Nuclear Generating Systems," Reactor and Fuel Processing Technology, Argonne National Laboratory, Fall 1969.

Cloud, R. L., "Structural Mechanics Applied to Pressurized Water Reactor Systems," Nuclear Engineering and Design, Vol. 46, No. 2, April 1978.

American Society of Mechanical Engineers, "Criteria of the ASME Boiler and Pressure Vessel Code for Design by Analysis," Sections III and VIII, Division 2, NY, NY, 1972.

Prepared by Weidlinger Assoc., Electric Power Research Institute, "Nonlinear Soil-Structure Interaction," Palo Alto, CA, EPRI NP-945, 1978.

Prepared by Science Applications Inc., Electric Power Research Institute, "Study of Nonlinear Effects on One-Dimensional Earthquake Response," Palo Alto, CA, EPRI NP-865, 1978.

Prepared by URS/ John Blume, & Associates, Electric Power Research Institute, "Applications in Soil-Structure Interaction," Palo Alto, CA, EPRI NP-1091, 1979.

Bohm, George, J., "Damping for Dynamic Analysis of Reactor Coolant Loop Systems," Topical Meeting on Reactor Safety, Salt Lake City, UT, Conf-730304 Avail, NTIS. March 1973.

Cloud, R. L. "Seismic Capability of Nuclear Piping," Unpublished, 1979.

Prepared by URS/John Blume, & Associates, for USNRC, "Nonlinear Structural Analysis Procedures for Category I Structures," Sept. 1978.

Prepared by D'Appolonia Consulting Engineers for USNRC, "Seismic Input and Soil-Structure Interaction," NUREG/CR-0693, Feb. 1979.

2. A listing of NRC Consultants:

N. M. Newmark, University of Illinois
W. J. Hall, University of Illinois
R. P. Kennedy, EDAC
J. C. Stepp, FUGRO
R. L. Cloud, R. L. Cloud Consultants
J. M. Roesset, University of Texas

3. The table provided in Enclosure 2 addresses this point.

4. The following table provides the necessary information.

Task No.	Lead Division	Contractor	FY1978	Amount		Task Objective
				FY1979	FY1980	
1.0	DOR	LLL	304,000	0		Quantify seismic conservatisms
2.0	DOR	LLL	80,000	0		Develop and evaluate elasto-plastic analysis techniques
3.0	DOR	LLL	70,000	0		Develop methods to determine site-specific response spectra
4.0*	DOR	LLL	*	*		*
5.0	DSS	URS/John Blume	62,000	0		Develop nonlinear seismic analysis methods
6.0	DSS	D'Appolonia	142,000	29,000		Evaluate soil-structure interaction analysis
7.0	DSE	Systems, Science and Software	0	65,000	101,000	Develop earthquake source modeling methods
8.0 & 9.0	DSE	LLL		57,000	58,000	Develop methods to determine strong-motion near-field spectra
10.0	RES	LLL		279,000**		Review results of program, modify SRP
TOTALS			658,000	430,000	159,000	

*Project was deleted.

**An additional \$75K has been requested for Task #3.

**Total funding includes amounts associated with Task #3.

(a) CATEGORY A SUBJECT NO.	(b) TITLE OF CATEGORY A GENERIC SAFETY ISSUES	(c) ASPECTS OF RESEARCH PROGRAMS DIRECTLY SUPPORTING THE GENERIC SAFETY ISSUES	(d) FY1979 FUNDING FOR (c)	(e) FY1980 FUNDING FOR (c)	(f) ASPECTS OF RESEARCH PROGRAMS INDIRECTLY SUPPORTING THE GENERIC SAFETY ISSUES (not listed in NUREG-0371)	(g) FY1979 FUNDING FOR (f)	(h) FY1980 FUNDING FOR (f)
*A-1	Water Hammer	Although it is not mentioned in NUREG-0371, research manpower and program funds were provided in FY1979 and will be provided in FY1980.	\$170K	\$50K	An additional research program on "Steam Condensation Induced Water Hammer" will support research needs in this area.	0	\$150K
*A-2	Asymmetric Blowdown Loads on the Reactor Vessel	None	None	0	Research program to develop load combination criteria will support this area.	0	\$300K
*A-3	Westinghouse Steam Generator Tube Integrity	PNL: Steam Generator Tube Integrity BNL: Inconel 600 Steam Generator Tube Corrosion ORNL: Eddy Current Nondestructive Examination	\$430K	\$985K (A-3,4,5)	None	0	0
*A-4	Combustion Engineering Steam Generator Tube Integrity	Same as A-3			None	0	0
*A-5	Babcock & Wilcox Steam Generator Tube Integrity	Same as A-3			None	0	0

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*A-6	Mark I short Term Program	1. 1/5 scale test series at LLL to obtain confirmatory pool dynamic load data (FIN No. A0118) 2. MIT program to investigate scaling relationships for hydrodynamic phenomena, fluid-structure interaction effects, and steam chugging phenomena (FIN No. B6167) 3. UCLA program to investigate air and steam venting into water pools. (FIN NO. B5875)	\$100K \$130K \$115K	0 0 0	LLL programs to develop computer program to analyze fluid-structure interaction effects. (FIN No. A0116)	\$500K	\$200K
*A-7	Mark I Long Term Program	Same as A-6					
*A-8	Mark II Program	1. MIT program to investigate scaling relationships for hydrodynamic phenomena, fluid-structure interaction effects and steam chugging phenomena. (FIN No. B6167). 2. UCLA program to investigate air and steam venting into water pools (FIN No.		0	LLL program to develop computer program to analyze fluid-structure interaction effects. (FIN NO. A0116)	(\$500K, A-6)	(\$200K, A-6)

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*A-9	ATWS	Research staff assistance is provided to review ATWS documentation and estimate risk from ATWS	\$36K	0	Research staff sponsors a program which estimated failure rates for control rod drive mechanism systems by evaluating LEKs. The Engineering Technology Engineering Center did a literature search on pressurizer safety/relief valve discharge under ATWS conditions. This was at the request of NRR.		0
*A-10	BWR Nozzle Cracking	ORNL: HSST Program	\$2087K (A-11,26)	\$1890K (A-11,26)	SWRI: Ultrasonic Testing in Field Applications Univ. Mich: Fast Reliable Ultrasonic Testing Detection	(\$160K, A-14) (\$237K, A-14)	(\$150K, A-14) (\$100K, A-14)
*A-11	Reactor Vessel Material Toughness	ORNL: HSST Program	(\$2087K, A-10,26)	(\$1890K, A-10,26)	NRL: Irradiation Effects in LWRs NSRDC: Elastic Plastic Specimen Shape Wash. Univ: Tearing Instability BCL: Crack Arrest	\$700K \$100K \$108K \$305K	\$800K \$100K \$175K \$325K

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*A-12	Fracture Toughness of Steam Generator and Reactor Coolant Pump Supports		0	0	ORNL: Pressure Vessel Simulation Experiment HEDL: Surveillance Dosimetry NBS: Dosimetry Data Base	\$790K \$540K \$72K	\$750K (A-11,12) \$500K (A-11,12) \$ 90K (A-11,12)
A-13	Snubbers		0	0	Research program on snubbers and restraint devices will support this issue	\$90K	\$150K
A-14	Flaw Detection	PNL: Acoustic Emission Material Univ. Mich: Fast Reliable Ultra- sonic Detection SWRI: Ultrasonic Test- ing in Field	\$350K \$237K \$160K	\$400K \$100K \$150K	ORNL: Eddy Current Non- destructive Examination PNL: Integration of Non- destructive Examination and Fracture Mech. Daedalean: Incipient Flaw Detection	(\$58K, A-3) \$274K	(\$145K, A-3) \$645K
A-15	Primary Coolant System Decontamination	No direct research	0	0	BNL: Inconel 600 Steam Generator Tube Corrosion	(\$210K, A-3)	(\$225K, A-3)
A-16	Steam Effects on BWR Core Spray		0	0	This physical phenomenon will be investigated in the NRC/GE/EPRI program in Lynn, Massachusetts facility in FY1980-1982	\$600K	\$1.5M (estimate)

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*A-17	Systems Interaction	Research provides staff assistance to formulate and review the NRR technical assistance program	0	0	None	0	0
A-18	Pipe Rupture Design Criteria	None	0	0	BCL: Cold Leg Break Criteria Sandia: Two-Phase Jet Loads LLL: Pipe Whip Evaluation NSRDC: Elastic Plastic Specimen Shape NRL: Irradiation Effects in LWRs Wash. Univ: Tearing Instability PNL: Integration of Non-destructive Examination and Fracture Mech.	\$200K 0 0 \$100K (\$700K, A-11) (\$108K, A-11) (\$274K, A-14)	\$200K \$350K \$150K (\$100K, A-11) (\$800K, A-11) (\$175K, A-11) (\$645K, A-14)
A-19	Digital Computer	None	0	0		0	0
A-20	Impacts of Coal Fuel Cycle	Research manpower and funds were provided in FY1978, 1979 and 1980	0	0	The program supportive of this issue is entitled "Health Effects of Radiological and Nonradiological Pollutants"	\$160K	\$100K

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A-21	Main Steamline Break Inside Containment	None	0	0		0	0
A-22	Main Steamline Break Outside Containment	None	0	0		0	0
A-23	Containment Load Test	None	0	0	None	0	0
*A-24	Qualification of Class IE Safety Related Equipment	Sandia Laboratories is working to develop methodology for: - aging - radiation source term - testing	\$775K	\$600K	None	0	0
A-25	NonSafety Loads on Class IE Power Sources	None	0	0	None	0	0
*A-26	Reactor Vessel Pressure Transient Protection (over pressure)	None	0	0	Heavy Section Steel Technology Research NSRDC: Elastic Plastic Specimen Shape NRL: Irradiation Effects in LWRs Wash. Univ: Tearing Instability BCL: Crack Arrest	(\$2087K, A-10, 11) (\$100K, A-11) (\$700K, A-11) (\$108K, A-11) (\$305K, A-11)	(\$1890K, A-10, 11) (\$100K, A-11) (\$800K, A-11) (\$175K, A-11) (\$325K, A-11)

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A-27	Reload Application Guide	None	0	0	Most of the LWR fuel research provides generic information on evaluation of reload applications. However, A-27 is the development of a Regulatory Guide giving guidelines for reload core applications.	0	0
A-28	Increase in Spent Fuel Storage Capacity	Although not directly mentioned in NUREG 0371, research manpower was provided in FY1979 and additional manpower may be necessary in FY1980.	0	0	This issue involves development of licensing positions and generic criteria for storage of spent fuel at reactor facilities. No research need has been identified in support of this issue.	0	0
A-29	Design Features to Control Sabotage	Research effort to directly support the need in this area will be concluded at the end of FY1979.	\$600K	(total funds through FY1979 \$1600K)	Additional research effort indirectly supportive of this issue is on "Development of Evaluation Methods for Physical Protection."	0	0
A-30	Adequacy of DC Power Supplies	Research administrators (for NRR) and provides staff assistance to a program evaluating the adequacy of current design criteria for DC power supplies.	\$ 60K	\$100K	None	0	0

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*A-31	RHR Shutdown Requirements	None	0	0	Research supports a program to provide an integrated technical basis for future regulatory actions regard- ing shutdown heat removal systems. This includes a review of current design criteria and practices and identification of the potential threats to and vulnerabilities of these systems.	\$100K	\$200K
A-32	Evaluation of Overall Effects of Missiles	No research need has been identified for this issue yet.	0	0	None	0	0
A-33	NEPA Reviews	Research sponsors a program to evaluate the risk from Class 3-8 accidents as required by NEPA reviews.	\$180K	\$100K	None	0	0
A-34	Instruments for Monitoring Radiation and Process Variable during Accidents	None	0	0	None	0	0
A-35	Adequacy of offsite Power Systems	None	0	0	None	0	0
*A-36	Heavy Loads Near Spent Fuel	None	0	0	None	0	0

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A-37	Turbine Missiles	Research support needed for this issue relates to damage probability. Research manpower was provided in FY1979. No additional need is anticipated.	0	0	None	0	0
A-38	Tornado Missiles	Research manpower and funds were provided in FY1979. Additional support is not anticipated in FY1980.	\$ 41K	0	Additional funds are being budgeted for research program on "Aircraft Impact Effects." The results will be useful for this issue.	0	\$100K
*A-39	Determination of Safety Relief Valve (SRV) Pool Dynamic Loads and Temperature Limits for BWR Containments	None	0	0	MIT program is evaluating scaling relationships for SRV discharge. FIN No. B6167.	0	0
*A-40	Seismic Design Criteria - Short Term	Research manpower and funds were provided in FY1979 for program management and support of research efforts. Additional research manpower and funds may be necessary in FY1980.	\$170K	0	The primary program in FY1980 on effective seismic input addresses the research need in this area.	0	\$150K

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A-41	Seismic Design Criteria - Long Term (This generic task has been deleted. The long term research program entitled "Seismic Safety Margins Program" discussed in Column (e) will supply much of the information originally envisioned as part of this task.)	A program entitled, "Seismic Safety Margins Program" was initiated in FY1979 and will continue through FY1980. This is a major research effort directed to the licensing need in this area.	\$2303K	\$2450K	Many seismic research programs underway and planned will support the research need in this area. The major programs are on regional seismic studies, geotechnical studies, dynamic testing, earthquake hazard assessments and qualification tests of equipment.	\$275K	\$4330K
*A-42	Pipe Cracks In Boiling Water Reactors	None	0	0	None	0	0
*A-43	Emergency Sump Reliability	None	0	0	None	0	0
*A-44	Station Blackout	None	0	0	None	0	0
TOTAL			\$8212K	\$7195K		\$4914K	\$11,465K
<p>1. Some of the research programs are useful for several generic issues. Those funds, shown in parentheses, are associated with other issues, and are not counted in the total research funds.</p> <p>2. The total sum of direct and indirect support for FY1979 is \$13,126K which is approximately 9% of FY1979 research budget. (\$143,480K)</p> <p>3. The total sum of direct and indirect support for FY1980 is \$18,660K which is approximately 11% of FY1980 research budget. (\$168,000K)</p>							

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