SQUG

Volume 3, Issue 3 | Seismic Qualification Utility Group Newsletter | October 1995

NEW SOFTWARE AVAILABLE

by Richard Starck, MPR

SQUG is making available to its members two new software packages: a Windows™-based CD-ROM version of the SQUG earthquake experience database software and a "Knowledge Base" of all the messages posted to the forums in the SQUG electronic bulletin board system (BBS).

These software packages can be used by SQUG members to assist in closing out the plant-specific USI A-46 programs (including outlier resolution) and in verifying the seismic adequacy of new and replacement equipment and parts to be installed in A-46 plants.

Windows™ CD-ROM Earthquake Experience Database

The new version of the earthquake experience database software runs in a Windows™ environment. It uses a single CD-ROM containing the results of equipment performance during major earthquakes. This version of the database software uses the same data CD-ROM as the previous DOS version. However, it can be run on a standard Windows™ platform without need of the special "J-Peg" data compression/decompression card or the use of an obsolete video driver required to operate the DOS version of the earthquake experience database software.

In addition to the features contained in the previous version of the earthquake experience database software (e.g., perform Boolean searches), the new version incorporates several features asked for by users to enhance its useability. These features include the capability to print out results, to cut and paste text, photos, and graphics, and to open several parts of the database at the same time and view them simultaneously on the screen.

SQUG members may order a free copy of this new version of the earthquake experience database software from the Electric Power Software Center by calling (800) 763-3772 and asking for the "SQUG Database, Windows™ Version."

SQUG is currently working on an expanded version of the earthquake experience database. This next version, expected to be released in early 1996, will include new data from the 1993 Guam earthquake and the 1994 Northridge earthquake. Since the addition of this new data exceeds the storage capacity of a single CD-ROM, this future version of the database will be produced as a two CD-ROM set. Look for an announcement of the release of this future version.

SQUG BBS Knowledge Base

A Windows™-based program and associated database has been developed containing all the messages which have been posted to the forums on the SQUG bulletin board system (BBS). This SQUG BBS "Knowledge Base" allows the user to not only read the BBS forum messages without connecting to the BBS via a modem (or via Internet), but also provides the capability to easily perform Boolean searches for words or topics. It also allows the user to add notes and bookmarks for later reference.

A copy of this program on diskette will be sent to the SQUG representatives by October 16, 1995. Users of the SQUG BBS will also be able to download a copy of the SQUG BBS Knowledge Base from the Library of Files (Library: BBSKB) on the SQUG BBS.

In the future, quarterly updates to the Knowledge Base will be forwarded to SQUG member representatives.

ANOTHER CREATIVE USE OF SQUG TECHNOLOGY

by R. P. Kassawara, SQUG Program Manager

Tennessee Valley Authority has recently made a new, innovative use of seismic experience data for evaluation of HVAC duct supports at Brown's Ferry. Enclosed with this newsletter is a copy of an EPRI "Innovator" on this application. Innovators formally document creative uses of EPRI technology including their cost savings. They receive wide industry distribution and are a good way for us to publicize the benefits of our efforts. We have placed copies of both SQUG related Innovators (this one and the WEPCO diesel generator evaluation) in our SQUG "Information for Prospective Members" marketing package which is given to potential members, e.g., international utilities.

We would like to encourage each SQUG member to review your applications of SQUG technology and consider having us produce an Innovator. Your applications do not have to be unique as long as you can reasonably define your cost benefit. To have your application of SQUG technology considered for an EPRI "Innovator," simply contact Robert Kassawara by phone, 415-855-2775; fax, 415-855-1026, or E-mail, RKASSAWA@MSM.EPRI.COM.

SQURTS-to-GERS CONVERSION

by Kelly Merz, EQE

SQUG has obtained shake table test data from the Seismic Qualification Reporting and Testing Standardization (SQURTS) organization and is in the process of updating existing Generic Equipment Ruggedness Spectra (GERS) with this new data and producing new GERS as appropriate. SQUG members will be able to use the new GERS from this project to complete their USI A-46 program (including resolution of outliers) and to qualify new and replacement equipment and parts to be installed in their A-46 plants.

The purpose of this article is to describe the process being used to convert SQURTS shake table test data into

GERS and to provide a list of the makes and models of equipment for which GERS are being developed.

A peer review of the SQURTS-to-GERS conversion is currently underway. The results of this project will be published later this year by EPRI.

Data Obtained From the SQURTS Organization

As of May 1995, the SQURTS data library consisted of 165 data items which had been tested in the SQURTS program[1] plus 10 additional "historical" test reports which had been submitted to SQURTS by utilities. The SQURTS test contractor provided SQUG with the summary test results on magnetic media in the GERS compatible text format as detailed in EPRI NP-5223 Appendix A. The historical data was provided on hard copy SQURTS summary data sheets. A general sort of the SQURTS data provided by generic classes yielded the following breakdown:

75	Relay, contactor, and timer items
8	Molded case circuit breakers
17	Switch components
9	Process Switches
13	Solenoid valve and valve components
10	Gauges and indicating meters
12	Control components
29	Miscellaneous components
2	Transmitters
175	Total items

In addition to the documentation provided by SQURTS, the SQURTS test contractor provided answers to questions as they arose during SQUG's review of the data.

Conversion of SQURTS Data to GERS

The transmitted data was first reformatted into sortable database files (dBase format) which are compatible with any Windows database or spreadsheet software. Each data item was reviewed for GERS applicability and to ensure that no conflict with existing GERS was apparent. As can be noted from the above data classification breakdown, the majority of the test data was for relays. Additional data items representative of equipment classes with existing GERS were Process Switches, Transmitters, and Solenoid Valves. Molded case circuit breakers (MCCB) were identified as a class for which suitable data was available to construct a new GERS Class.

The review indicated that some of the testing was conducted to site specific SSE levels with a "structural integrity" check (functional after) at the shake table limits (approximately 14 g spectral acceleration, 5% damping). However, much of the testing was fragility testing conducted to establish the functional limits of the devices under test. Some of the SQURTS data library items were similar or identical items tested to the same or repeat test levels.

The SQURTS relay test data was reviewed to determine what type of tests were performed (site qualification or fragility) and which specific models were tested. Test data for use in generating GERS was identified for about 46 relay models. For this set of relay data, approximately 12 models had existing GERS which were confirmed or exceeded by the SQURTS test levels. It was determined that three of these relay models with existing GERS were not based on fragility test results (i.e., functional performance) but rather on the limits placed on prior shake table testing (10 g). Thus, these three relay models were identified as candidates for increased capacity based on the SQURTS test results. The remaining 34 relay models were assigned new GERS levels based on the SQURTS data. Since the GERS for process switches and transmitters are model specific, the SQURTS data review indicated that six new process switch models and two new transmitter models could be added to the models covered by the existing GERS levels. The GERS for solenoid valves apply to a generic equipment class, thus the existing GERS levels were confirmed by the SQURTS test results.

The SQURTS test data for MCCB, along with existing EPRI test data (NP-5024) and confirming results from the MCC and Distribution Panel GERS, were used to construct a new GERS for MCCB. While MCCB are common components of Motor Control Centers (MCCs), panelboards, and switchboards, they are also mounted in other enclosures and control cabinets. The new GERS, which is model generic (similar to the contactor and motor starter GERS in EPRI Report NP-5223), should be helpful for screening of these components in the USI A-46 program and for use in replacement part evaluations.

Summary of Makes and Models Covered

The makes and models of transmitters and process switches which can be added to the list covered by existing GERS (NP-5223) are listed in Table 1.

Table 1

Models of Transmitters & Process Switches
For Which GERS Are Developed
From SQURTS Data

Class	Type	Manufacturer	Model
Transmitters	Pressure	Leeds & Northrup	2610-101
	Temperature	Rochester Instrument	ESC-1372
Process Switches	Temperature	Square D	9025CXW
	Temperature	Square D	9025CYN
	Pressure	Square D	9012GAW
	Pressure	Johnson Controls	970DA
	Pressure	Mercoid	DAW-9023

The makes and models of relays for which GERS are developed from SQURTS data are summarized in Table 2. The 34 new new relays are listed for which new GERS are developed. This table also includes those relays for which GERS already exist and are confirmed by the new data and also includes those relays with existing GERS but for which an increase in capacity is warranted based on the new test data. A few low ruggedness relays are listed for which the new data provides resolution or confirmation information.

---

[1] *See the December 1994 edition of the SQUG Newsletter for a description of the SQURTS program and its relationship to the SQUG program for New and Replacement Equipment (NARE) and the EPRI program on Generic Seismic Technical Evaluation of Replacement Items (G-STERI).*

Table 2
Relay Models for Which GERS Are Developed From SQURTS Data

RELAY TYPE	MANUFACTURER	MODEL	NOTES
Existing GERS - Confirming Data			
Auxilary Relay - Hinged Arm	General Electric	HFA151 (DC)	12HFA151A2H tested
Auxilary Relay - Industrial Type 2	Westinghouse	BFD	BFD62S tested
Auxilary Relay - Pneumatic Timing	General Electric	CR2820B	CR2820B413AA41 tested to site specific SSE
Auxilary Relay - Socket Type	Struthers-Dunn	219	219ABAP (120 VAC), 219ABAP (120 VDC), 219BBXP (48 VDC) tested
Contactor	Square D	EB440PA-5	
Protective Relay - Miscellaneous (Undervoltage)	ASEA Brown Boveri (ITE)	ITE-27	ITE-275239U6-345 tested
Existing GERS - Increased Capacity			
Auxilary Relay - Industrial Type 2	Allen-Bradley	700N	700N400A1, 700N600A1 tested
Auxilary Relay - Pneumatic Timing	Agastat	E7012	E7012AD, E7012AE tested
Auxilary Relay - Socket Type (in Vol.2)	Potter & Brumfield	KUP11	KUP11A15-120 VAC, KUP11D15-12 VDC, KUP11D15-24 VDC tested
Low Ruggedness - Resolution/ Confirmation			
Auxilary Relay - Hinged Arm	ASEA Brown Boveri (W)	SG (DC)	1161540-C tested
Auxilary Relay - Hinged Arm	General Electric	HFA65D (AC)	12HFA65D84H tested w/98VAC pull-in adjustment
Protective Relay - Induction Cup (Loss Of Excitation)	General Electric	CEH	12CEH51A1A tested
New Relay GERS			
Auxilary Relay - Industrial Type 1	Cutler-Hammer	D26MR	D26MR22A tested
Auxilary Relay - Industrial Type 2	Krause & Naimer	S1400B	S1400B5500044, S1400B1200044 tested
Auxilary Relay - Industrial Type 2	Allen Bradley	700DC-N	700DC-N-300Z1 tested
Auxilary Relay - Industrial Type 2	Furnas Electric	41DB	41DB30AF tested
Auxilary Relay - Lockout Type	General Electric	HEA61	12HEA61A225-X2 tested
Auxilary Relay - Miscellaneous	Eagle Signal	HP5	HP58A6 tested
Auxilary Relay - Miscellaneous	General Electric	NGA	12NGA15AG3 tested in system
Auxilary Relay - Miscellaneous	Power Conversion Products	120 Hour Timer 913182	timer only tested
Auxilary Relay - Miscellaneous	Precision Timer Co.	120 Hour Timer J1NM2V1/120 HD 6A	timer, knob & scale tested
Auxilary Relay - Miscellaneous	Automatic Timing & Controls	Reset Timer 305E	305E007A10PX tested
Auxilary Relay - Pneumatic Timing	Allen Bradley	700DC -NT	700DC-NT-300Z1 tested
Auxilary Relay - Pneumatic Timing	Agastat	7012-L, -T	auxilary contacts - assessory items tested
Auxilary Relay - Socket Type	IDEC	RH	RH2B-UDC110V, RH3B-UDC24V tested
Auxilary Relay - Socket Type	Agastat	GPIA	w/ & w/o Tie Wrap Security Cover
Auxilary Relay - Socket Type (off-delay timing)	Agastat	SSC2	SSC22ACA tested
Auxilary Relay - Socket Type (on-delay timing)	Agastat	SSC1	SSC12ALA tested
Auxilary Relay - Socket Type (on-delay timing)	Agastat	SCCLA01	SCCLA012XXAMXA tested
Auxilary Relay - Socket Type (interval timing)	Agastat	SCCLA03	SCCLA032XXABXA tested
Auxilary Relay - Socket Type (time delay)	Potter & Brumfield	CNT-35-96	
Protective Relay - Induction Disk (Group 1) (Low Voltage Pick-up)	General Electric	IAV51K	12IAV51K1A tested to site specific SSE
Protective Relay - Induction Disk (Group 1) (Overvoltage)	General Electric	IAV512D	12IAV51D1A tested to site specific SSE
Protective Relay - Induction Disk (Group 1) (Undervoltage)	General Electric	IAV54E	12IAV54E1A tested to site specific SSE
Protective Relay - Induction Disk (Group 1) (Directional Power)	General Electric	ICW51B	12ICW51B4A tested
Protective Relay - Induction Disk (Group 2) (Overcurrent)	ASEA Brown Boveri (W)	CO-6 SN 264C898A05	
Protective Relay - Definite Time Over Current Relay	ASEA Brown Boveri	SN 468S3275	
Protective Relay - Miscellaneous (Polyphase Power Directional)	General Electric	GGP53C	12GGP53C1A tested
Protective Relay - Miscellaneous (Under Frequency)	ASEA Brown Boveri	MDF-2 SN 1357D42A27	Aged
Protective Relay - Miscellaneous (Under Frequency)	ASEA Brown Boveri	MDF SN 1357D42A247	Aged
Protective Relay - Miscellaneous (Generator Differential)	ASEA Brown Boveri (W)	SA1 SN 290B225A10	
Protective Relay - Miscellaneous (Machine Field Ground Detector)	General Electric	PJG12	12PJG12B1A tested in system
Protective Relay - Miscellaneous (Overexcitation)	General Electric	STV	12STV11A4A tested in system
Protective Relay - Miscellaneous (Overvoltage)	Wilmar	300X	Cycle Aged
Protective Relay - Miscellaneous (Synchronizing)	General Electric	GES21A	12GES21A1D cycle aged and tested
Protective Relay - Miscellaneous (Undervoltage)	Basler	BEI-27	BEI-27-A3E-E1J-A1N6F tested

NEWSLETTER CORRECTION
by Paul Baughman, EQE

The September 1995 issue of the SQUG Newsletter, in the article reporting on the results of a study of equipment failures from the 1994 Northridge earthquake, requires clarification regarding transformer short circuits. First, there were six damaged transformers in Northridge; the seventh was in the Loma Prieta earthquake. Second, while all had damage, only one had a short circuit (the one which caught fire) and this was within the coil and not due to contact with the metal enclosure. The short occurred when the porcelain coil supports broke, causing the coil to shift. This failure illustrates the potential for damage when porcelain elements are used in the internal load path. All of the damaged units had ratings greater than 750 KVA and did not have internal bracing for the core-coil assembly. Finally, the mentioned transformers with internal bracing were not at the same sites as those with damage.

SEISMIC QUALIFICATION UTILITY GROUP (SQUG)

UTILITY STEERING GROUP:
Neil Smith, Chairman (Commonwealth Edison)
James Thomas (Duke Power)
William Metevia (Yankee Atomic)
Donald Moore (Southern Company Services)
Richard Cutsinger (Tennessee Valley Authority)

TECHNICAL MANAGEMENT:
Program Manager: Robert Kassawara (EPRI)
Technical Coordinator: William Schmidt (MPR)

The Seismic Qualification Utility Group (SQUG) was formed in 1982 to develop a technically sound and cost effective alternative for verifying the seismic adequacy of equipment installed in older nuclear power plants. This newsletter reports on the generic activities of the SQUG program as well as the results and lessons learned from utility implementation of the SQUG methodology.

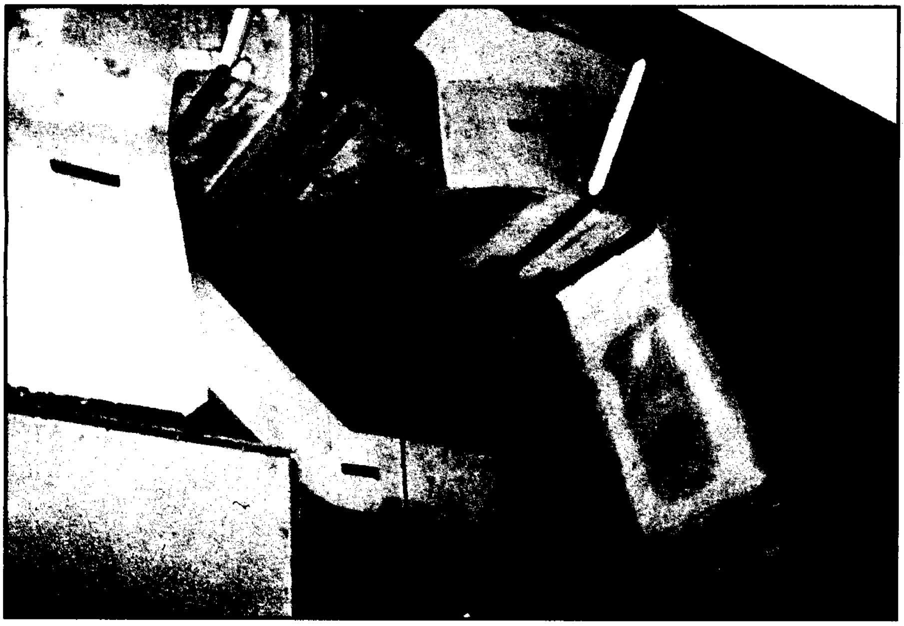
Comments, questions, suggestions, and contribution of articles may be forwarded to:

Richard Starck (MPR), Editor
SQUG Newsletter
320 King Street, 4th Floor
Alexandria, VA 22314-3238
Phone: 703-519-0200
FAX: 703-519-0224

SQUG Newsletter
320 King Street, 4th Floor
Alexandria, VA 22314-3238

EPRI

Innovators with EPRI technology



EPRI/SQUG METHODOLOGY EXTENSION RESULTS IN COST-EFFECTIVE VERIFICATION OF SEISMIC ADEQUACY FOR HVAC DUCT SUPPORTS

"The EPRI/SQUG methodology was extended for use in the seismic adequacy verification of HVAC duct supports at Browns Ferry, Unit 2, and resulted in cost savings of about $1.6 million to WA."

■ **Rick Cutsinger**
Tennessee Valley Authority

BENEFITS

■ **The EPRI/SQUG methodology was applied to verification of the seismic adequacy of heating, ventilating, and air conditioning (HVAC) duct system supports. This extension of the methodology resulted in cost savings of-more than $1.5 million compared to a planned standard review approach.**

Challenge

One of the constant challenges for nuclear power plant civil engineering departments is to seek out and develop cost-effective, technically sound methodologies for verifying the seismic adequacy of critical structures, systems, and components. Seismic qualification technologies have changed since the original design of older, operating nuclear power plants. These changes have raised questions about the original seismic design bases and seismic qualification methods for existing plant features.

Consequently, nuclear power plant civil engineering organizations are faced with the need to reanalyze and validate the seismic adequacy of identified plant features. Many times this requires significant resources. Incurred costs include detailed engineering analyses, supported by as-built data collection and design data verification walkdown efforts. The engineering evaluations are performed using conservative criteria based on perceived regulatory requirements, which may result in the installation of costly retrofit modifications to ensure compliance.

Nuclear facility economic viability is reduced by increasing operation and maintenance (O&M) expenditures or capital expenses, which include the redesign and modification of existing structures, systems, and components. The use of these resources also reduces the capability that a nuclear power plant management team has to make other facility improvements in order to increase safety or enhance operational efficiency.

As nuclear power plants become older, additional modifications are subject to increasing scrutiny by utility management. This level of scrutiny has led plant management to institute economic feasibility studies to identify cost-effective, technically sound alternatives.

Challenge

Continued from other side

The Tennessee Valley Authority (TVA) was presented with this form of challenge at the Browns Ferry Nuclear Power Plant, Unit 2, licensed in 1972. This came about when the seismic adequacy of Seismic Class 1 HVAC duct systems was called into question.

Response

EPRI and SQUG have developed screening criteria and procedures, based on earthquake experience data, shake table tests, and limited analytical review to verify the seismic adequacy of nuclear power plant systems and components. The current version of the SQUG Generic Implementation Procedure (GIP) addresses electrical and mechanical equipment, cable trays and conduit systems and supports, and horizontal and vertical tanks and heat exchangers. The focus of the SQUG GIP is closure of the U.S. Nuclear Regulatory Commission (NRC) unresolved Safety Issue (USI) A-46. The GIP also covers seismic adequacy verification of new and replacement equipment, parts, and raceway systems and supports. HVAC duct systems and supports are not specifically within the scope of USI A-46 and the SQUG GIP.

Tennessee Valley Authority (TVA) had the performance of HVAC duct systems in past earthquakes investigated. It was found that the HVAC duct seismic experience data, like the seismic experience data for mechanical and electrical equipment, could provide a technically sound basis for verifying the seismic adequacy of HVAC duct systems and supports at the Browns Ferry Nuclear Plant. HVAC duct support screening criteria, consistent with the SQUG GIP, were developed and then discussed with and submitted to the NRC for formal review. TVA received a safety evaluation report (SER) from the NRC, accepting the use of the EPRI/SQUG methodology.

The new HVAC seismic adequacy screening criteria were implemented at TVA's Browns Ferry Nuclear Plant. Relative to implementation of more conventional criteria, it is estimated that use of the EPRI/SQUG approach for HVAC duct supports resulted in significant cost savings. The need for about 75 support modifications was eliminated. In particular, elimination of these support modifications also eliminated the need to construct scaffolding over the control room (for construction of support modifications).

It has been estimated that total savings of approximately $1.6 million were realized. This significantly reduced O&M expenditures by TVA civil engineering. Furthermore, a recent Institute of Nuclear Power Operations (INPO) review at Browns Ferry Nuclear Plant commended the TVA civil engineering organization's innovative and cost saving approach for this HVAC duct seismic qualification program.

Estimated Savings of TVA's Application

	Saving **($000)**
Platform over Control Room	1,000
Construction for 75 modifications	350
Engineering for 75 modifications	150
Document control process reductions	50
Construction engineering support	50
Total Savings	$1,600

References

- *The Generic Implementation Procedure for Seismic Verification of Nuclear Plant Equipment.* Seismic Qualification Utility Group, March 1993.
- *Summary of the Seismic Adequacy of Twenty Classes of Equipment Required for the Safe Shutdown of Nuclear Power Plants.* EPRI NP 7149-D, March 1991.

EPRI publications are available from the EPRI Distribution Center, (510) 934-4212.

For further information, contact:

Electric Power Research Institute
P.O. Box 10412, Palo Alto, CA 94303

R. P. Kassawara, Project Manager
Nuclear Power Group
(415) 855-2775

Interest Categories

- Seismic hazards and engineering

EPRI *Leadership in Electrification through Global Collaboration*

Post Office **Box 10412, Palo Alto, CA 94303 EPRI Hotline** (415) 855-2411

Printed with soya inks on recycled paper (50% recycled fiber, including 20% postconsumer waste) in the United States of America

© 1995 Electric Power Research Institute. Inc., Electric Power Research Institute, and EPRI are registered trademarks or service marks of the Electric Power Research Institute, Inc.

RPSQOI

August 1995

IN-I 04633