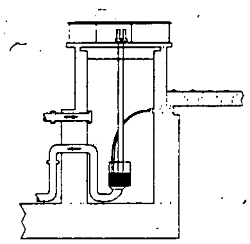

14th U.S. TRIGA Users Conference

April 5-8, 1994

General Atomics, San Diego, California

FINAL PROGRAM

AND

SUMMARY OF PAPERS

GENERAL ATOMICS

FINAL PROGRAM

Tuesday, April 5

6:30 - 8:30 p.m.	Registration and Reception - Mission Room Foyer

Wednesday, April 6

8:00 - 9:00 a.m.	Registration; Coffee and Danish - Mission Room Foyer
9:00 a.m.	Session I
1:30 p.m.	Session II

Thursday, April 7

8:00 a.m.	Coffee and Danish - Mission Room Foyer
9:00 a.m.	Session III
1:30 p.m.	Session IV
6:30 - 9:00 p.m.	Dinner Buffet on William D. Evans

Friday, April 8

8:00 a.m.	Coffee and Danish - Mission Room Foyer
9:00 a.m.	Session V
10:45 a.m.	Depart for General Atomics Tours

All technical sessions and discussions will take place in the Mission Room.

Session I - **Wednesday, April 6, 9:00 a.m.**

9:00 Welcome

Brian Thurgood, Managing Director, TRIGA Reactors (GA)

9:15 The Early Development and Use of the TRIGA Reactor

W. L. Whittemore (General Atomics)

9:45 Results of the MCNP Analysis of 20/20 LEU Fuel for the Oregon State University TRIGA Reactor

B. Dodd, A. C. Klein, B. R. Lewis, P. A. Merritt (Oregon State University)

10:15 - 10:45 Coffee Break

10:45 Upgradeable 2MW TRIGA Reactor Design for the Morocco Nuclear Energy Center

A. R. Veca (General Atomics)

11:15 McClellan Nuclear Radiation Center TRIGA Reactor: Four Years of Operations

C. C. Heidel and W. J. Richards (McClellan AFB)

SEA PORT VILLAGE

The Early Development and Use of the TRIGA Reactor

by

W. L. Whittemore
General Atomics
San Diego, California

A review of the first few years of the TRIGA* Reactor project is interesting since a new research reactor concept was being developed quite early in the history of research reactors in the United States. Unusual at that time were the unique features of the TRIGA reactor being developed. It is also interesting to review the licensing procedures in effect in 1958. The initial AEC license for a 10 kW U-ZrH_x reactor with a 15 kW refrigerator cooling system was upgraded to 1 MW within a few months of the initial criticality in May 1958. A photographic record of the rapid development from the initial to the early commercial version of TRIGA reactors will be presented. The first tentative, and then serious, efforts to pulse the Mark I TRIGA reactor will also be discussed.

*TRIGA is a registered trademark of General Atomics.

NOTES

TOUR - 9 a.m. SCRIPPS ACQUARIUM

Welcome — JAPAN, AUSTRALIA. - MEXICO. - Nederland

JUNE - 1958 1st LICENSED OPERATORS.

Abstract for the 14th TRIGA Users Conference

Results of the MCNP Analysis of 20/20 LEU Fuel for the Oregon State University TRIGA Reactor

by

B. Dodd, A. C. Klein, B. R. Lewis, P. A. Merritt

The Monte Carlo Neutron/Photon (MCNP) code has been used to perform the neutronics analysis required to support revision of the Oregon State University TRIGA Reactor (OSTR) Safety Analysis Report (SAR). The SAR revision is a necessary part of the preparation of the application for authorization to convert the OSTR core from High Enriched Uranium (HEU) FLIP fuel to a Low Enriched Uranium (LEU) fuel. Before MCNP was applied to LEU-fueled cores, it was first validated by comparing MCNP calculations on FLIP cores to historical, measured values for these cores. The LEU fuel considered was the 20 wt%, 20 % enriched (20/20) TRIGA fuel approved by the Nuclear Regulatory Commission (NRC) in NUREG 1282.

The results show that the 20/20 fuel is much more reactive than FLIP fuel. A just-critical OSTR FLIP core contains 65 elements, while a just-critical 20/20 core only needs 51 elements. Similarly, the current operational FLIP core consists of 88 elements, whereas a 20/20 core giving the same core excess only requires 65 elements. This presents a significant problem for the OSTR because of potentially significant neutron flux loss in experimental facilities. Further analysis shows that to achieve a full size operational core of about 90 LEU elements the erbium content of the LEU fuel would need to be increased from 0.47 wt% to about 0.85 wt%.

NOTES

UPGRADEABLE 2 MW TRIGA® REACTOR DESIGN FOR THE MOROCCAN NUCLEAR ENERGY CENTER

by

Anthony R. Veca
General Atomics

ABSTRACT

The Moroccan TRIGA® is a 2 MW steady state reactor which will be located at the Centre d'Etudes Nucleaires de la Maamora (CEN) near the city of Kenitra in Morocco. The CEN will be operated by the Centre National de l'Energie, des Sciences et des Techniques Nucleaires (CNESTEN). The reactor is a steady state Mk-II design which is cooled by natural convection of the reactor tank water and has the latest TRIGA® designs and features. These include a 2.5 m reactor tank, a thermal column, four beam tubes, a digital control system and console, and control rods with stepping motors. A key feature of the design is that all permanent components and structures have been designed for operation at 3 MW. This will allow a relatively simple and inexpensive upgrade to this power level at some future time should CNESTEN desire it.

Component fabrication is nearly complete and most have been delivered and are being stored in Morocco. CNESTEN is currently preparing bid specifications for the design and construction of the CEN. Proposals will be solicited with design and construction scheduled to begin in early 1995. Once the reactor hall is completed, installation of the reactor system can begin. It is estimated that to complete the installation and commissioning the reactor for operation at 2 MW will take about three months.

NOTES

McClellan Nuclear Radiation Center (MNRC) TRIGA Reactor

Four Years of Operations

By

C.C. Heidel, W.J. Richards

SM-ALC/TIR
5335 Price Ave.
McClellan Air Force Base
Sacramento, CA 95652-2504

Abstract

McClellan Air Force Base, at Sacramento, California, is headquarters for the Sacramento Air Force Logistics Center (SM-ALC). McClellan Air Force Base provides extensive inspection and maintenance capabilities for the F-111, F-15, and other military aircraft.

Criticality of the MNRC TRIGA reactor was obtained on January 20, 1990 with 63 standard TRIGA fuel elements, three fuel-followed control rods and one air-followed control rod. Presently there are 93 fuel elements in the reactor core. The reactor can be operated at 1 MW steady state power, producing pulses up to three dollars worth of reactivity addition, and can be square waved up to 1 MW.

The reactor core contains a circular grid plate and a graphite reflector assembly surrounding the core. Four tangential beam ports installed in the reflector assembly provide a thermal neutron flux to four radiography bays. The reactor tank is twenty-four (24) feet deep, seven and one-half (7.5) feet in diameter, and has a protrusion in the upper portion of the reactor tank. This protrusion is scheduled for use as a neutron thermal collimator in the future.

Besides the neutron radiography capabilities, the reactor contains a pneumatic rabbit system, a central thimble, an in-core irradiation facility, and three additional cutouts that provide locations for additional irradiation facilities. The central thimble can be removed along with the B-ring locations of the upper portion of the grid plate to provide an additional and larger in-core irradiation facility. A new upper grid plate has been manufactured to expand one triangular cutout so that larger experiments can be inserted directly into the reactor core.

Some operational problems experienced during the first four years of operations are the timeout of the CSC and DAC watchdogs, deterioration of the heat exchanger gaskets, and loss of thermocouples in the instrumented fuel elements.

NOTES

Session II - Wednesday, April 6, 1:30 p.m.

1:30 Challenges of Change
W. L. Rigot and C. W. Kocher (Dow Chemical)

2:00 UIUC Control Console Installation and Upgrade
Richard L. Holm (University of Illinois)

2:30 Experience of R.S.R. Replacement after 31 Years of Operation
Y. Takami (Rikkyo University)

3:00 - 3:30 Break

3:30 Modification of the Penn State Reactor to Allow Transverse and Rotational Core Motion to Increase Operational Versatility
Daniel E. Hughes (Penn State University)

4:00 Activation Analysis Using the Cornell TRIGA
Tim Z. Hossain (Cornell University)

Challenges of Change

By

W. L. Rigot C. W. Kocher

Analytical Sciences Laboratory, Dow North America, Midland, Michigan

The Dow TRIGA® Mark I nuclear reactor achieved first criticality on July 6, 1967. Since then it has been modified and improved to take advantage of instrumental progress and to avoid obsolescence. The reactor has been primarily used as a source of neutrons for neutron activation analysis (NAA) for the nuclear chemistry group within the Analytical Sciences Laboratory, which serves the Dow manufacturing and research facilities world-wide.

This reactor, initially licensed to operate at 100 kilowatts, was previously owned, and came equipped with a vacuum-tube based control system bearing the serial number 1. In 1971 and 1973 new transistor-based equipment, a wide-range linear channel and a wide-range log channel, respectively, was installed, a considerable improvement. Fifteen years later a microprocessor-based instrumentation and control system was introduced by General Atomics (GA) to take advantage of instrumentation improvements and to provide replacements for equipment which could no longer be maintained. This system was installed at Dow in late 1990.

The license was improved: at the time of the 1986 license renewal effort changes were made which allowed the reactor to be operated at power levels of up to 300 kilowatts in order to improve analytical sensitivity. That license, issued in 1989, is for a twenty-year span, which takes the facility well into the next century. Another license amendment in 1990 allowed the installation of the digital safety channel used in the new GA system.

The new microprocessor-based system brought new ways of operating the new problems. Maintenance items now include network components and hard disks, among others, and different modes of operation are required. There have been a great number of computer-related unintentional shutdowns; our experience with this shows slow improvement.

Significant improvements have been made in the instrumentation used for the NAA program. The original equipment was based on NaI(Tl) detectors (with one 5% Ge(Li) detector), sample changers, and dedicated multichannel pulse-height analyzers. The present instrumentation is based on an Ethernet-connected Micro Vax® computer which controls two multi-channel analyzer systems, a robot sample server for two shielded systems each using two HPGe detectors, and an automated pneumatic sample transport system, with its own detector, for short half-life materials. The computer features automated data acquisition and reduction and can be accessed from desktop computers in the laboratory and from home computers.

The very first operation of the reactor at 100 kilowatts in 1967 resulted in release of radioactive materials from a leaking fuel element, which was then identified and replaced. Very recently we have some experience of rare and sporadic episodes of extremely low-level releases of radioactive materials, which may be related to the concept of "tramp uranium". Investigation continues.

NOTES

UIUC Control Console Installation and Upgrade

By

Richard L. Holm

University of Illinois

The University of Illinois Nuclear Reactor Laboratory shutdown in March of 1993 to install the General Atomics digital control console. Two weeks of this period were devoted to refurbishment of the rod drives and two weeks were the actual installation of the console. Much of the wiring necessary to install the console was done during the period when the rod drives were being refurbished. A few mistakes were made along the way.

- A "repaired" extension cord was temporarily used to supply power to the DAC...the ground and neutral were reversed...this was not appreciated by the DAC! We had to replace a couple of the boards in the DAC after that little fiasco.

- The instrumentation cables for the rod drives were received with the plugs all connected and ready to install...except you can't put a two inch plug through a half inch conduit. We had to cut the plugs off, run the cable through the conduit, and then resolder the plugs on where the rod drive assembly connects (my privilege).

- We had to replace the memory board in the NM1000 in order to prevent it from losing its mind every time it got turned off.

- There were problems with the pulse data acquisition that were eventually traced to a problem in the ribbon cable between the mother and daughter boards.

All in all the installation and operation of the console went fairly well. There are still occasional glitches, but none serious or excessively annoying.

The console installation is part of an upgrade program to replace all of the instrumentation in the facility with the modern equivalent. The pressure and flow sensors, currently air operated, are being replaced with 4-20 ma transmitters for input into the control console and into a mimic board for the primary and secondary systems.

Through the funding of the now defunct, temporarily we hope, Reactor Instrumentation Program we have upgraded our area radiation monitors as well. These upgrades provide us with more reliable equipment as well as consolidating some equipment into less space. This is helping us remove some older cabinets from our control room to free up space.

Other upgrades that are in the works are replacement of the 8.5 wt/o fuel with 20 st/o fuel to allow for extended operation and removal of the lazy susan. The lazy susan space will be replaced with a grid system for sample holders similar to the Neutron Activation Tube.

Last, but not least, and totally unrelated to the console installation, the college has finally conceded to paint the inside of the Nuclear Reactor Laboratory for the first time in 34 years.

NOTES

NAME	AFFILIATION
BRYAN LEWIS	Atom Analysis, Inc.
RUPERTO MAZON	Instituto Nacional de Investigaciones Nucleares
MARVIN MENDONCA	U.S. Nuclear Regulatory Commission
GEORGE MILLER	University of California Irvine
STEPHEN MILLER	Armed Forces Radiobiology Research Institute
MARK MOORE	Armed Forces Radiobiology Research Institute
JOHN O'BRIEN	McClellan AFB Nuclear Radiation Center
WILLIAM PHILLIPS	Idaho State University
JUNAID RAZVI	General Atomics
WARD RIGOT	The Dow Chemical Company
JOE ROSS	Argonne National Laboratory NRAD Reactor
ROGER SCHLICHT	General Atomics
KAREN SCHULTZ	General Atomics
DR. MASSOUD SIMNAD	University of California, San Diego
JIM SIMPSON	Gamma-Metrics
JAMES SNELGROVE	Argonne National Laboratory
ROBERT SPENCE	U.S. Nuclear Regulatory Commission
MAHESH SUTHAR	National Institution of Standards & Technology
YASUKIYO TAKAMI	Institute for Atomic Energy, Rikkyo University
BRIAN THURGOOD	General Atomics
ANTHONY VECA	General Atomics
ANTHONY VINNOLA	EG&G Idaho Inc.
ANGELIA WEEKS	McClellan AFB Nuclear Radiation Center
DANIEL WESTALL	Australian Nuclear Safety Bureau
WILLIAM WHITTEMORE	General Atomics

Junaid Razvi, Chairman
Karen Schultz, Arrangements

Phone: (619) 455-3277
Fax: (619) 455-3865

NAME	AFFILIATION
HOWARD ADERHOLD	Cornell University
ISAMU (SAM) AOKI	EG&G Idaho, Inc.
CLARK ARTAUD	Gamma-Metrics
JEFF BELL	Rust Federal Services, Inc.
DAVID BLANK	EG&G Nuclear Instruments
JEANNOT P. BOOGAARD	ECN Nuclear Energy
ROBERT BOSTON	Idaho State University
WALTER BRAUER	U.S. Air Force Safety Agency
DAVE BROWN	National Institute of Standards & Technology
HARY CHARYULU	Idaho State University
FORREST CLARK	National Institute of Standards & Technology
JAMES CRUMP, III	McClellan AFB Nuclear Radiation Center
JAMES DITTMER	Westinghouse Hanford Company
BRIAN DODD	Oregon State University
CHARLES HEIDEL	McClellan AFB Nuclear Radiation Center
PAUL G. HELFER	U.S. Geological Survey
RICHARD HOLM	University of Illinois
BRUCE HOSELTON	U.S. Department of Energy
TIM HOSSAIN	Cornell University
DANIEL HUGHES	Penn State University
WILLIAM HYDE	General Atomics
JOSE IBARRA	U.S. Nuclear Regulatory Commission
ARTHUR JOHNSON	Oregon State University
KEVEN KIGER	McClellan AFB Nuclear Radiation Center
RAYMOND KLANN	Argonne National Laboratory-West
SHINSHO KOBAYASHI	JAERI

Experience of R.S.R. Replacement After 31 Years Operation

By

Y. Takami

Institute for Atomic Energy Rikkyo University

Yokosuka, Japan

Rikkyo's RSR has served well for 30 years under the maximum thermal output of 100 kW. We have made the cleaning of the old RSR inside with acetone whenever we had serious difficulty in its rotation - 4 times all together in its 30 operation years. In 1991 the rotation became extremely difficult, and it seemed it would be inevitable to replace the old with the new one, which we have purchased from GA and kept since 1978. The integrated power output was 2,346,199 kWh, when the actual replacement work was made in the summer of 1992.

This work has been made with very valuable information supplied by GA people when needed.

Estimated radiation levels around RSR when lifted above the water tank and the discrepancy with the observed values, troubles encountered in the work and how they were solved will be presented at the Conference.

NOTES

Modification of the Penn State Reactor to Allow Transverse and Rotational Core Motion to Increase Operational Versatility

by

Daniel E. Hughes
Penn State University

At Penn State the Nuclear Engineering students have the opportunity to perform experiments in reactor physics, work with reactor and radiation instrumentation, and operate a nuclear reactor. These activities are done at the Penn State Breazeale Reactor (PSBR), a General Atomics Mark III TRIGA reactor. Unfortunately this activity alone can not fully support the facility. The PSBR is mandated by Penn State to provide a portion of its operating budget by selling services to users outside as well as inside Penn State. In order to increase the marketability of PSBR an upgrade program was started to increase the quality and versatility of operation.

The PSBR is the longest operating university reactor in the United States. The first phase of the upgrade program began in 1992. The quality of operation was increased by replacing a 1965 vintage console with a more reliable digital control and monitoring system.

The present phase of the upgrade program is to increase the versatility of operation by modifying the reactor to allow transverse and rotational core motion. Adding two more degrees of motion to the reactor core increases the capability of the facility to meet the needs of present and future users. This upgrade is being financed by a grant from the Department of Energy and matching funds from Penn State.

NOTES

Activation Analysis Using Cornell TRIGA

By

Tim Z. Hossain

Cornell University

A major use of the Cornell TRIGA is for activation analysis. Over the years many varieties of samples have been analyzed from a number of fields of interest ranging from geology, archaeology and textiles. More recently the analysis has been extended to high technology materials for applications in optical and semiconductor devices. Trace analysis in high purity materials like Si wafers has been the focus in many instances, while in others analysis of major/minor components were the goals. These analysis has been done using the delayed mode. Results from recent measurements in semiconductors and other materials will be presented. In addition the near future capability of using prompt gamma activation analysis using the Cornell cold neutron beam will be discussed.

NOTES

Session III - **Thursday, April 7, 9:00 a.m.**

9:00 Evaluation of NSRR Reactor Characteristics using a Core Transient Behavior Simulation Code EXCURS-NSRR
S. Katanishi, S. Kobayashi, O. Horiki, S. Otomo and K. Ishijima (JAERI)

9:30 Demonstration and Results of the Research Reactor Analysis Program
Bryan R. Lewis (Atom Analysis, Inc.)

10:00 Cross Sections for Fuel Depletion and Radioisotope Production Calculations in TRIGA Reactors
Ruperto Mazon Ramirez (ININ)

10:30 - 11:00 Coffee Break

11:00 Neutron Tomography: McClellan Nuclear Radiation Center TRIGA Reactor
J. C. Crump III, K. Shields, D. Newell, K. Kiger and C. Friday (McClellan AFB)

11:30 Rapidly Pulsed TRIGA Reactor: An Intense Source for Neutron Scattering Experiments
W. L. Whittemore (General Atomics)

Evaluation of NSRR Reactor Characteristics
using a Core Transient Behavior Simulation Code EXCURS-NSRR

S. Katanishi, S. Kobayashi, O. Horiki
S. Otomo and K. Ishijima

Department of Reactor Safety Research
Japan Atomic Energy Research Institute

ABSTRACT

The Nuclear Safety Research Reactor(NSRR) in Japan Atomic Energy Research Institute(JAERI) is a modified TRIGA-ACPR(Annular Core Pulse Reactor) which was constructed in 1975 in order to investigate the fuel behavior mainly under reactivity initiated accident(RIA) conditions. This reactor generates very sharp pulse power with the maximum of 23GW by rapid reactivity insertion of the maximum of 4.7$, and has capability to simulate a power burst in RIAs of power reactors. Fuel failure mechanisms and the fuel failure threshold in RIAs have been investigated through irradiation of test fuel rods in the NSRR.

The control system and the operation data acquisition system of the NSRR were modified in 1989. By the modification, the controlled high power operation with various power shape became possible. Also on-line data acquisition of reactor data such as reactor power, regulating rod position, and so on, became possible by the modification. Evaluation of reactor characteristics became easy and accurate by detailed comparison of the time history of operation data and calculation results.

Authors have tried to evaluate some parameters or constants of reactor characteristics by using a core transient behavior simulation code EXCURS-NSRR which consists of one point reactor kinetic equations and thermal equations of driver fuel and coolant. Especially in a relatively small and slow pulse power generation with reactivity insertion of less than 1$, evaluation of feedback reactivity coefficient and relation between reactivity insertion and regulating rod position was conducted. This article presents the evaluation results by the comparison between obtained reactor data and parametric calculation results.

NOTES

Demonstration and Results of the Research Reactor Analysis Program

by

Bryan R. Lewis
Atom Analysis, Inc.

The Research Reactor Analysis Program (RRAP) uses a well established Monte-Carlo Transport code (MCNP) to provide accurate reactivity values, flux spectra values and sample activation levels. RRAP is an Object-Oriented based program that is both preprocessor and postprocessor for MCNP. RRAP allows a user unfamiliar with MCNP to easily construct a complicated input file that utilizes various MCNP features via a graphical interface and windows environment. RRAP also processes the large output file from MCNP and performs various calculations to display the parameters of interest. RRAP can operate on various computer platforms (i.e., personal computer, Sun workstation, HP workstation, etc.).

The version of RRAP that is presented at this conference was customized for the Oregon State University TRIGA reactor. This version allows fuel shuffling, burnup calculations and in-core irradiation analysis. The data for each fuel rod and it's time spent in each position was used to calculate excess reactivity as a function of core life. This data is compared with the measurements that were taken on a daily basis at OSU since 1976. An in-core irradiation calculation will be performed using gold foils and the results will be compared to actual reactor measurements of the same configuration (hopefully this work will be completed prior to the conference). A live demonstration of RRAP as well as the documented results and benchmarks will be presented.

NOTES

Cross Sections for Fuel Depletion and Radioisotope Production Calculations in TRIGA Reactors

Aguilar H. F., Mazon R. R.
National Institute of Nuclear Research (ININ)

For TRIGA Reactors, the fuel depletion and isotopic inventory calculations, depends on the computer code and in the cross sections of some important actinides used. Among these we have U-235, U-238, Pu-239, Pu-240 and Pu-241. We choose ORIGEN2, a code with a good reputation in this kind of calculations, we observed the cross sections for these actinides in the libraries that we have (PWR's and BWR), the fission cross section for U-235 was about 50 barns. We used a PWR library and our results were not satisfactory, specially for standard elements.

We decided to calculate cross sections more suitable for our reactor, for that purpose we simulate the standard and FLIP TRIGA cells with the transport code WIMS. We used the fuel average flux and COLAPS (a home made program), to generate suitable cross sections for ORIGEN2, by collapsing the WIMS library cross sections of these nuclides.

For the radioisotope production studies using the Central Thimble, we simulate the A and B rings and used the A average flux to collapse cross sections. For these studies, the required nuclides sometimes are not present in WIMS library, for them we are planning to process the ENDF/B data, with NJOY system, and include the cross sections to WIMS library or to collapse them using the appropriate average-flux and the program COLAPS.

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Neutron Tomography

McClellan Nuclear Radiation Center (MNRC) TRIGA Reactor

By

J.C. Crump III, K. Shields, D. Newell, K. Kiger and C. Friday

SM-ALC/TIR
5335 Price Ave.
McClellan Air Force Base
Sacramento, CA 95652-2504

Abstract

At the MNRC Reactor Facility we are currently in the process of converting one of our real-time radiography bays into a neutron tomography facility. The facility's initial use will be for the determination of the amount of hydrogen in titanium compressor blades. An increase in the amount of hydrogen within the blade can result in embriddlement and later structural failure of the fan blade. The blades are "baked" (heated to high temperatures to force the hydrogen from the blade) after a number of flying hours. The goal of the system is to enable the end user to know when blades have reached potentially damaging levels of hydrogen (greater than 125 ppm). The system also needs to be able to process a large number of blades in a short time (i.e. a production mode).

To achieve the goal of detecting the hydrogen at the appropriate levels; maxmize through put, and give the system flexibility to be used in other applications several unique features were incorporated. These design features included; a high resolution CCD camera for imaging, multiple high capacity turn tables to minimize system fixturing time, and automatic image analysis for hydrogen content.

The high resolution CCD camera was selected based on previous work at the facility done by Dr. Eric McFarlan of University of California at Santa Barbara. He originally used the ST-4 and ST-6 which had small rectangular arrays of 375x242. For the system we chose the Princeton Instruments TE-1024K which has a segmentable (can be partitioned in smaller areas) array of 1024x1024. The camera also has the ability to digitize image information at 16 bit resolution or as low as 8 bit for high speed. Additionally, the CCD camera sensitivity (quantum efficiency) was matched closely to the wavelength of light emitted by the scintillation screen.

The turn tables used have a weight capacity of 2000 pounds. This is well above the weight of the fan blade (less than one pound). To increase the through put we placed 3 blades on each turn table. Then the blades are imaged as if they are a single object. There are four tables each sitting on a large aluminum plate. A single AC brushless servo motor drives the tables in unison. The aluminum plate sits on a Aronson positioner which is manually indexed to place individual tables infront of the neutron beam. This enables twelve blades to be imaged without having to stop to fixture more.

Finally, the automatic instead of manual interpretation of the images frees the operator and enables off-line processing. Since the image intensity is proportional to the hydrogen content of the imaged blade it is quite easy to develop formula to return some value proportional to the hydrogen content. The application of this algorithm is accomplished through implementation of basic image processing rules.

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ϕ + r –

SCINTILLATION SCREEN AF 426

SENDO MTR → NEMA /34 SIZE

RAPIDLY PULSED TRIGA REACTOR: AN INTENSE SOURCE FOR NEUTRON SCATTERING EXPERIMENTS

by

William L. Whittemore

General Atomics

The need for ever increasing intensities of thermal neutron beams for neutron scattering experiments has stimulated the development of intense steady state research reactors such as the 53-MW ILL reactor at Grenoble. The source flux at the reactor end of the beam ports is typically 10^{15}n/cm^2.s for its thermal neutron beams. To achieve still higher source fluxes of neutrons, the family of pulsing IBR was developed. In this type of facility the pulse repetition (RUSSIAN) rate is low (~5/sec) typically but the instantaneous peak fluxes are high, ranging up to 5 x 10^{15}n/cm^2.s at the surface of the moderator. Another type of intense neutron source is that exemplified by the proton synchrotron accelerators with their spallation targets. The first of these has been the IPNS at Argonne National laboratory. This neutron source produces 30 pulses per second with an individual peak thermal neutron intensity of 4 x 10^{14}n/cm^2.s from the moderator.

An equivalent, alternative intense neutron source can be based on a rapidly pulsed TRIGA reactor. With a pulsed thermal neutron intensity of more than 10^{15}n/cm^2.s occurring 50 times per second at the source end of beam ports, the rapidly pulsed TRIGA reactor combines some of the best features of the pulsed fast reactors such as IBR-2 and the spallation neutron sources but with the safety of a thermal neutron reactor with a large, prompt, negative temperature coefficient of reactivity. The initial concept of the rapidly pulsed TRIGA reactor was developed and initially reported in 1966. Subsequently, the standard fuel format for U-ZrH_x fuel has been developed to include a small diameter fuel particularly well suited for the rapidly pulsed application. This fuel is LEU, satisfying all the requirements for non proliferation, and has a very long core life time. In the proposed application, the peak fuel temperature does not vary more than 1°C from the average peak fuel temperatures during each pulse. Hence long term metallurgical stability is thus assured. With a core lifetime that can be designed for up to 10,000 MWD, operation at an <u>average</u> power of 10 MW (with peak pulsed powers of ~50 MW) with an equilibrium core can be conducted for 1000 full power days.

NOTES

Session IV - Thursday, April 7, 1:30 p.m.

1:30 A 5 MW TRIGA Reactor Design for Radioisotope Production
A. R. Veca, W. L. Whitemore (General Atomics)

2:00 A Database System for Enhancing Fuel Records Management Capabilities
P. E. Rieke, J. Razvi (General Atomics)

2:30 U. S. Air Force Performance-Based Training as Applied to TRIGA Reactor Operations
W. C. Brauer, A. A. Weeks (McClellan AFB)

3:00 - 3:30 Coffee Break

3:30 U. S. University TRIGA Fuel Purchase Schedule
A. J. Vinnola, I. Aoki (INEL)

A 5 MW TRIGA® REACTOR DESIGN FOR RADIOISOTOPE PRODUCTION

by

Anthony R. Veca, William L. Whittemore
General Atomics

ABSTRACT

The production and preparation of commercial-scale quantities of radioisotopes has become an important activity as their medical and industrial applications continue to expand. There are currently various large multipurpose research reactors capable of producing ample quantities of radioisotopes. These facilities, however, have many competing demands placed upon them by a wide variety of researchers and scientific programs which severely limit their radioisotope production capability. A demonstrated need has developed for a simpler reactor facility dedicated to the production of radioisotopes on a commercial basis. This smaller, dedicated reactor could provide continuous fission and activation product radioisotopes to meet commercial requirements for the foreseeable future.

The design of a 5 MW TRIGA® reactor facility, upgradeable to 10 MW, dedicated to the production of industrial and medical radioisotopes is discussed. A TRIGA® reactor designed specifically for this purpose with its demonstrated long core life and simplicity of operation would translate into increased radioisotope production. As an example, a single TRIGA® could supply the entire US needs for Mo-99. The facility is based on the experience gained by General Atomics in the design, installation, and construction of over 60 other TRIGAs® over the past 35 years. The unique uranium-zirconium hydride fuel makes TRIGA® reactors inexpensive to build and operate, reliable in their simplicity, highly flexible due to unique passive safety, and environmentally friendly because of minimal power requirements and long-lived fuel.

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A Database System For Enhancing Fuel Records Management Capabilities

Phil Rieke & Junaid Razvi
General Atomics
San Diego, California

The need to modernize the system of managing a large variety of fuel related data at the TRIGA® Reactors Facility at General Atomics, as well as the need to improve NRC nuclear material reporting requirements, prompted the development of a database to cover all aspects of fuel records management. The TRIGA Fuel Database replaces (a) an index card system used for recording fuel movements, (b) hand calculations for uranium burnup, and (c) a somewhat aged and cumbersome system of recording fuel inspection results. It was developed using Microsoft Access™, a relational database system for Windows™. Instead of relying on various sources for element information, users may now review individual element statistics, record inspection results, calculate element burnup and more, all from within a single application.

Taking full advantage of the ease-of-use features designed in to Windows and Access, the user can enter and extract information easily through a number of customized on screen forms, with a wide variety of reporting options available. All forms are accessed through a main 'Options' screen, with the options broken down by categories, including 'Elements', 'Special Elements / Devices', 'Control Rods' and 'Areas'. Relational integrity and data validation rules are enforced to assist in ensuring accurate and meaningful data is entered.

Among other items, the database lets the user define: element types (such as FLIP or standard) and subtypes (such as fuel follower, instrumented, etc.), various inspection codes for standardizing inspection results, areas within the facility where elements are located, and the power factors associated with element positions within a reactor. Using fuel moves, power history, power factors and element types, the database tracks uranium burnup and plutonium buildup on a quarterly basis.

The Fuel Database was designed with end-users in mind and does not force an operations oriented user to learn any programming or relational database theory in order to take advantage of the information it contains.

NOTES

U.S. Air Force Performance-Based Training

As Applied To TRIGA Reactor Operations

By

CMSgt W.C. Brauer and A.A. Weeks

SM-ALC/TIR
5335 Price Ave.
McClellan Air Force Base
Sacramento, CA 95652-2504

Abstract

In January 1991 the Air Force Safety Agency (AFSA) licensed a nuclear reactor for operation at McClellan Air Force Base in Sacramento, California.

McClellan's TRIGA reactor provides a neutron source for the Sacramento Air Logistics Center's nondestructive inspection facilities. The reactor is also used extensively for both Department of Defense and commercial neutron irradiations.

The key to safe and reliable reactor operations lies with the operations staff. The reactor operators at the McClellan TRIGA reactor are civil service employees. The initial reactor operators received training from General Atomics in San Diego, California. Once the reactor became fully operational, however, additional candidate operators were added to the staff. Experience showed that the time from hiring a candidate operator to certification was about two years.

The McClellan reactor operator training program was vastly improved through the initiation of two significant changes. First, a new level of reactor operator, the reactor console operator (RCO) was established. Second, a performance based training program was developed and implemented.

The new RCO operator level brought several efficiencies to the reactor operator training and certification process. Like an RO, the RCO must have the knowledge and skills to operate the reactor during normal, abnormal and emergency conditions. However, RCOs are not certified to perform reactor related maintenance or fuel handling activities. RCO candidates concentrate on reactor operations, while reactor related maintenance and fuel handling training remains at the RO level. The result is a shorter initial training period, with certification to RCO in about six months.

The second significant change was the development and implementation of a performance based training program. This required an in depth analysis of the responsibilities of all three operator levels (RCO, RO, SRO). The performance based training program ensures that the required training is delivered to a candidate at the correct time, and at the correct level in their training process. Overtraining is minimized and undertraining is eliminated, resulting in an efficient and effective reactor operator training program.

NOTES

Idaho National Engineering Laboratory

March 11, 1994

Juanid Razvi, Conference Chairman
General Atomics
TRIGA Reactors Facility Building 21
POB 85608
San Diego CA 92186-9784

USERS CONFERENCE ABSTRACT - AJV-15-94

Dear Mr. Razvi:

Please provide me with approximately 15 minutes during the conference to discuss current plans for TRIGA fuel needs and estimated purchase schedule. You may title this discussion, "U.S. University TRIGA Fuel Purchase Schedule".

Also, I would like to introduce the Department of Energy, Idaho Operations Office, University Reactor Fuel Assistance Program Manager, Mr. Isamu (Sam) Aoki. Sam will be in attendance with me.

Sincerely,

A. J. Vinnola Jr

A. J. Vinnola
INEL University Reactor Fuel Assistance,
Program Manager

AJV

cc: I. Aoki, DOE-ID, MS 1220

NOTES

<u>Session V</u> - Friday, April 8, 9:00 a.m.

9:00 TRTR Report

K. Kiger (McClellan AFB)

9:15 TRIGA Users Conference: Business Discussion and Announcements

9:30 Panel Discussion: TRIGA Technology and Related Issues

An open discussion with GA experts

10:45 Depart for General Atomics Tours

- Doublet III Tokomak Facility
- San Diego SuperComputer Center
- TRIGA Reactors Facility

McClellan Nuclear Radiation Center (MNRC) TRIGA Reactor

THE NATIONAL ORGANIZATION OF TEST RESEARCH AND TRAINING REACTORS

TRTR CONFERENCE

By

Kevin M. Kiger

SM-ALC/TIR
5335 Price Ave.
McClellan Air Force Base
Sacramento, CA 95652-2504

Abstract

This year's TRTR conference is being hosted by the McClellan Nuclear Radiation Center. The conference will be held at the Red Lion Hotel in Sacramento, CA. The conference dates are scheduled for October 11-14, 1994. Deadlines for sponsorship commitment and papers have not been set, but are forthcoming.

The newly remodeled Red Lion Hotel provides up-to-date conference facilities and one of the most desirable locations for dining, shopping and entertainment in the Sacramento area.

While attendees are busy with the conference activities, a spouses program will be available. Although the agenda has not been set, the Sacramento area offers outings to San Francisco, Pier 39, Ghirardelli Square (famous for their chocolate), and a chance to discover "El Dorado" in the gold country. Not to forget our own bit of history with visits to "Old Sacramento and Old Folsom," where antiquities abound, to the world renown train museum and incredible eating establishments.

NOTES

EXHIBITORS

1. **EG&G NUCLEAR INSTRUMENTS**

   Representative: David Blank

2. **GAMMA METRICS**

   Representative: Clark Artaud

3. **GENERAL ATOMICS**

   Representative: William Hyde

4. **RUST INTERNATIONAL, INC.**

   Representative: Jeff Bell

GENERAL ATOMICS

P. O. BOX 85608 SAN DIEGO, CA 92186-9784 (619) 455-3000