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**U.S. Department of Energy
UNIVERSITY REACTOR INSTRUMENTATION PROGRAM**

**Final Report for 1992-94 Grant
for the
University of Florida Training Reactor**

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FINAL REPORT ON UFTR 1992-94
UNIVERSITY REACTOR INSTRUMENTATION GRANT

1.0 Overview of Grant Usage

Recognizing that the U.S. Department of Energy University Reactor Instrumentation Program was developed in response to widespread needs in the academic community for modernization and improvement of research and training reactors at institutions such as the University of Florida, the items proposed to be supported by this grant over its two-year period had been selected as those most likely to reduce forced outages, to meet regulatory concerns that had been expressed in recent years by Nuclear Regulatory Commission inspectors or to correct other facility problems and limitations. Department of Energy Grant Number DE-FG05-92ER179151 was provided to the University of Florida Training Reactor (UFTR) facility through the University Reactor Instrumentation Program. The original proposal submitted in May 1992 requested support for UFTR facility instrumentation and equipment upgrades for thirteen (13) items in three categories in the amount of \$155,751 with \$18,700 of this amount to be the subject of cost sharing by the University of Florida and \$137,051 requested as support from the Department of Energy. A breakdown of the items requested and total cost for the proposed UFTR facility instrumentation and equipment improvements is contained in Table 1 synthesized from the proposal submittal.

The four items actually supported by the grant allocation in the 1992-93 grant year provided a starting point for the process of modernization and improvement at the University of Florida Training Reactor which, like the majority of such facilities, is over 35 years old. Although

several major instrumentation improvements were supported by the University of Florida around 1970 and later, it had been some years since significant funding had been available for reactor facility instrumentation upgrades until the instrumentation grants began in 1990. By no means did this 1992-93 grant meet all the clearly identified needs of a facility such as the UFTR, but it did allow the process to continue. For more details on the grant usage for the first year, the reader is referred to Section 2.0.

For the second grant year, the original proposal submitted in March 1993 requested more ambitious support for UFTR facility instrumentation and equipment upgrades for eighteen (18) items in the amount of \$284,034 with \$38,000 of this amount to be the subject of cost sharing by the University of Florida and \$246,034 requested as support from the Department of Energy. Again, these items were directed at improving reactor facility operation and addressing facility shortcomings identified by internal reviews related to forced outages and other limitations as well as concerns expressed by regional NRC inspectors. In the second grant year we again acquired and implemented badly needed instrumentation and equipment for the facility. Again, this support meets some clearly identified needs but by no means does it mean even a significant fraction of all the identified needs of the facility has been met. The five items that have been acquired under the grant in the second year do assure that some key needs have been addressed.

2.0 Summary of First Year Grant Usage

For the first reporting year (1992-93), Department of Energy Grant DE-FG05-92ER79151 was provided to the University of Florida Training Reactor (UFTR) facility through the DOE's University Reactor Instrumentation Program. The original proposal submitted in March 1992

requested support for UFTR facility instrumentation and equipment upgrades for thirteen (13) items in the amount of \$155,751 with 12.01% cost sharing by the University of Florida. A breakdown of the items requested and total cost for the proposed UFTR facility instrumentation and equipment improvements is contained in Table 1 taken from the proposal submittal. It should be noted that the proposed UFTR facility instrumentation and equipment are subdivided into three categories (I) to improve reactor operations, (II) to improve existing facility/NAA laboratory operations and finally (III) to expand facility capability. All of these items were selected recognizing the objectives of the University Reactor Instrumentation Program to respond to the widespread needs in the academic reactor community for modernization and improvement of research and training reactor facilities, especially at large and diverse institutions such as the University of Florida. These needs are particularly pressing at the UFTR which is the only such research and training reactor in the State of Florida which is undergoing rapid growth in a variety of technical areas.

Although only a portion of the proposal could be funded, a number of key items were included in the first year (1992-93) grant referenced previously. Specifically, this DOE University Reactor Instrumentation Program grant was awarded for \$21,000 subject to an additional 12.01% cost sharing per the original proposal, to provide funds toward the purchase of the following much needed instrumentation:

1. Area Radiation Monitoring System
2. Telescan Telescoping High Dose Rate Survey Instrument
3. Portable Low Level Survey Instrument
4. Multipoint Temperature Recorder

The quoted estimated costs from the May 1992 proposal, the grant allocation costs and actual costs for the items covered under this grant are summarized in Table 2; in addition, total actual cost shown in Column 3 is \$866.95 less than was projected in the proposal with three of four items costing somewhat more than proposed and the three channel area radiation monitoring system costing considerably less due to a special educational institution discount. This savings means that the grant was charged as shown in Column 5 with cost sharing shown in Column 6 of Table 2. The unused portion of the grant at \$763.18 was then used to cover some of the implementation costs, especially for the area radiation monitoring system. Clearly, the funding supplied by this grant was well used in obtaining and implementing quality equipment at the best price possible.

As indicated in Table 2, the first item is an area radiation monitoring system which cost over \$1,300 less than originally quoted in the proposal and is a high quality replacement area radiation monitoring system as distinct from the stack effluent monitoring system. The area radiation monitor (ARM) instrument modules in the present system are no longer obtainable off-the-shelf and are prohibitively expensive to have made. These plugin-type modules had had frequent failures over the five years prior to 1992 as had the recorders, with this system responsible for up to four months unavailability for 1988-92 at a clearly generally increasing rate. In addition, because only two of three area monitors are required to be functional as a limiting condition for operation, there had been at least another five to six months in this period when one instrument module or one recorder had been removed for repair awaiting spare parts. Not only do such conditions detract from facility appearance and presentations for users, but they clearly indicated the poor condition of this system. With replacement, the facility will become much more reliable. In addition, the modernized instrumentation would be a useful feature for radiation protection and

systems training for various user groups. This system was also the source of three unscheduled shutdowns in the 1990-92 time frame. The system was bought and partially installed; however, a major overhaul on the existing system has allowed it to function reasonably well since 1993 so that full installation of this new system awaits the further acquisition of the replacement stack monitoring module which is very costly but for which funds have just been obtained. Currently this system is serving as a spare with plans to install in the next two years as part of the UFTR relicensing activities.

As indicated in Table 2, the second item is a Xetex Telescan Telescoping GM portable survey instrument for remotely monitoring high radiation areas which cost somewhat more (several hundred dollars) than quoted in the proposal. Lack of an in-house instrument had resulted in concerns about meeting ALARA considerations, especially with the limits in the new 10 CFR Part 20. Although such an instrument was available at the Emergency Support Center, it belongs to the University Radiation Control Office and had been the subject of considerable maintenance efforts in recent years. With fuel inspections requiring shielding unstacking and fuel exposure biennially as a minimum in the UFTR modified-Argonaut design plus other incore support structure and control blade inspections required less frequently, this instrument was acquired and is well used in assuring personnel doses are as low as reasonably achievable. Such an instrument is also important for monitoring radiation fields around incore instrument failures. Finally, this instrument is critical for reliable radiation dose measurements for the HEU-to-LEU core conversion expected to occur in 2000.

As indicated in Table 2, the third item is a low level survey meter suitable for measuring low and medium levels of gamma exposure rates and beta absorbed doses, especially at environmental

levels. It cost somewhat more than quoted in the original proposal. Although GM survey instruments are available for estimates of such levels and are well used, the preference for monitoring low level fields and samples for transfer is to use the true energy-dependent measurements only available using such a low level ionization chamber. Again, acquisition of this meter was also partially in response to NRC inspection comments and the need to monitor low levels external to the facility in less than restricted areas and do it more accurately than has been accomplished to meet the objectives of the new 10 CFR Part 20. The lack of ready availability of such a survey instrument had been the cause of operational delays and uncertainties in true sample and area radiation level readings in the past but has been corrected with the acquisition of the Bicorn Microanalyst survey instrument. Indeed, over the past five years it has been one of the facility's most reliable dose measuring survey instruments.

Finally for the 1992-93 grant, the fourth item is a replacement for the 12-point temperature recorder that cost a few dollars more than originally quoted. Due to the importance of the temperature monitor in the annual nuclear instrument power calibration, it has become necessary to obtain a new, more reliable and accurate temperature monitor. The existing monitor has been reasonably reliable; however, as it gets older, obtaining replacement parts has become more difficult. Indeed, to replace two amplifiers in the existing monitor would exceed the cost of a new top-of-the-line recorder such as the one obtained with this grant. Therefore, to assure meeting the recommendations of an NRC inspection concerning performance of an accurate nuclear instrument power calibration, especially when the new LEU core is first loaded, it is essential that a more versatile and reliable temperature recorder be in place. The acquired model also has a computer interface that will allow storage of data on disk and allow statistical studies to be done. As NRC

recommendations for preventive maintenance and calibration of instruments become more restrictive, this feature may become a necessity. At any rate this feature will prove to be a valuable teaching aid for operations-related laboratory sessions and for student projects related to thermal hydraulics of the UFTR. Currently this multipoint recorder is serving as a spare with plans for installation in progress for implementation as part of the HEU-to-LEU fuel conversion.

In general, all four pieces of instrumentation acquired in the first (1992-93) year are directly related to improving reactor safety, minimizing personnel doses per ALARA commitments, and addressing inspection concerns in recent years. With these acquisitions, radiation monitoring capabilities were significantly upgraded; in addition, having the new area radiation monitoring system partially installed provides excellent spare equipment as does the new temperature recorder, both of which will be implemented as part of the upcoming UFTR relicensing effort but are ready now in the event of failure of the installed equipment currently in use to meet technical specifications and safety requirements. The net result has been improved, more reliable reactor utilization in keeping with grant objectives; this has also meant increased user interest in facility utilization.

3.0 Summary of Second Year Grant Usage

For the second reporting year (1993-94), the Department of Energy Grant DE-FG05-92ER79151 (renewal) was again provided to the University of Florida Training Reactor (UFTR) facility through the DOE's University Reactor Instrumentation Program. The original proposal submitted in March 1993 requested support for UFTR facility instrumentation and equipment upgrades for eighteen (18) items in the amount of \$284,034 with 13.38% cost sharing by the

University of Florida. A breakdown of the items requested and total cost for the proposed UFTR facility instrumentation and equipment improvements is contained in Table 3 taken from the proposal submittal. It should be noted that the proposed UFTR facility instrumentation and equipment are subdivided into three categories (I) to improve reactor operations, (II) to improve existing facility/NAA laboratory operations and finally (III) to expand facility capability. All of these items were selected recognizing the objectives of the University Reactor Instrumentation Program to respond to the widespread needs in the academic reactor community for modernization and improvement of research and training reactor facilities, especially at large and diverse institutions such as the University of Florida. These needs are particularly pressing at the UFTR which is the only such research and training reactor in the State of Florida which is undergoing rapid growth in a variety of technical areas.

The five items actually supported by the grant allocation for 1993-94 all come from Category I or Category II of the proposal. As in the first grant year, they assure continuation of the process of modernization and improvement at the University of Florida Training Reactor. In future years, we would hope to make even greater progress in modernizing and improving reactor facility instrumentation, hopefully to include acquisition of some instrumentation in Category III to expand facility capabilities to meet expressed needs of the user community served by the University of Florida Training Reactor.

Although only a portion of the proposal could be funded, a number of key items were included in the second year (1993-94) of the DOE grant referenced previously. Specifically, this second year grant was awarded for considerably more support at \$32,799. An additional 13.38% cost sharing per the original proposal submitted in February 1993 was not included in the DOE

grant as the grant was implemented to provide the full proposal cost for purchase of the much needed instrumentation:

1. Ultrasonic Flow Meter
2. Remote Visual (Fiber Optics Extendable) Boroscope Inspection Package
3. Sample Freeze Dryer System
 - Freeze Dry Console (6 Liter Capacity)
 - Vacuum Pump
4. Infrared Moisture Analyzer
5. Portable Shielding Material (Ten Lead Blankets @ \$215)

The quoted estimated costs from the 1993 proposal and actual costs as well as status for the items covered under this grant are summarized in Table 4; in addition, total actual cost shown in Column 3 is \$45.47 less than was projected in the proposal with three items costing slightly more than proposed and two costing somewhat less. The big savings was an educational contract on the combined sample freeze dryer system including an integral instead of separate vacuum pump which had been previously quoted from a different vendor. This means that the grant was charged as shown in Column 5 with no cost sharing based on the grant as awarded. The unused direct portion of the instrumentation grant at \$45.47 was used to cover a small part of the costs of implementing the items obtained with the 1993-94 award, with the funding supplied by the grant well used in getting quality equipment at the best price possible.

First, as indicated in Table 4, the ultrasonic flow meter is a key nuclear safety-related item for assuring a complete flow rate standardization for the calorimetric heat balance and nuclear instrumentation calibration surveillance required to be performed at least yearly. It cost slightly

more than quoted due to shipping costs. This ultrasonic flowmeter will allow benchmarking the primary and secondary coolant flow rate in order to have a primary standard for coolant flow. The existing primary flow indication is a strain gauge with only one electronic calibration point. In order to verify a true reading, a precision instrument must be used to compare the strain gauge readings with those of a more accurate instrument. This item is needed for specific response to previous NRC inspection concerns and will continue to be of great use in future years, especially for benchmark work related to converting from the high-enriched uranium to low-enriched uranium fuel and also in relicensing efforts.

The second item per Table 4 is a remote visual (fiber optics extendable) boroscope inspection assembly which cost slightly less than originally quoted. This device was selected to be useful in core fuel inspections, control blade inspections and core support structure inspections, all of which are unique for the UFTR which is a modified Argonaut core design where every core inspection necessitates unstacking tons of shielding. This boroscope was obtained with fiber optics specifically to allow these interrogations to be undertaken in areas with very small clearances with much reduced personnel exposure and reduced risk of mechanical difficulty in unstacking the core. Much of the core support structural inspection as well as part of the control blade integrity inspections is now being accomplished without unstacking all of the core shielding and without the current requirement of no operations for the previous week, thus increasing reactor availability for useful applications. For all core area maintenance activities and especially for the HEU-to-LEU conversion now planned for 2000, it is essential to have such a device to meet ALARA considerations. The boroscope is unquestionably a major tool in reducing dose commitment and

in addition to saving several rem of dose over the past five years, can probably be credited with reducing total outage time by a week or so per year.

One of the significant limitations in usage of the UFTR facility has always been the throughput of the NAA Laboratory (NAAL). Even with improvements implemented with the FY 92 University Reactor Instrumentation Program grant as well as over \$20,000 of internal University of Florida support, throughput has continued to be the key limitation. The less personnel and equipment time used in the NAAL, the more usage of the reactor that can be accommodated. Several NAAL improvements had been implemented in the two years prior to the 1993-94 grant year including upgrading primary and support software packages for spectral analysis. In addition to the software, several additional improvements in the UFTR facility's existing NAAL capabilities were implemented with funding from the FY 92 instrumentation grant including an external multichannel buffer (MCB) to greatly improve performance in the real-time data acquisition in one of the two PC-based analyzer systems, incorporation of a spectrum master with several NIM modules in one package with several high level processing features, plus implementation of a low-background lead shield with a copper-cadmium liner to reduce the interference from lead X-rays for the HPGe detector to improve detector performance significantly. So the last three items supported by the 1993-94 grant provide equipment to improve and facilitate existing NAAL operation.

For the 1993-94 grant, as indicated in Table 4, the third item (two components) consists of a sample freeze dryer with connected integral vacuum pump which cost several hundred dollars less than originally quoted due to a discount on the integral arrangement. This freeze dryer system was obtained to improve not only the total NAAL throughput but also the quality of NAAL

results. The sample freeze dryer system now allows preparation of samples for activation in the reactor without heating to remove moisture. Though many samples can be dried in the laboratory oven, many other samples with volatile compounds or elements of interest (mercury for example) as well as many liquid and wet samples require, or at least would recommend, freeze drying to minimize loss of volatiles. Though the facility had access to a freeze dryer at the Physics Department in an adjacent building, it is frequently in repair or already in use resulting in delays for processing samples for NAA. Again, having this freeze drying capability in the laboratory assures proper control of samples, especially for visiting researchers, and has been well used for many research projects including such diverse projects as quantifying mercury in environmental sediments as well as detecting the uptake of mercury in critical organs of laboratory rats whose bones have been implanted with mercury amalgam materials to simulate human response to having dental cavities filled with such amalgam.

As indicated in Table 4, the fourth item is a much needed infrared moisture analyzer to provide precise determinations of moisture content. It cost about \$100 more than predicted primarily due to obtaining pens and paper for its operation. Since differences in moisture content in samples induce significant errors in the determination of trace element content, the identification of the percent moisture allows immediate correction for this material in the analysis procedure. Thus, analysis error due to moisture can be eliminated or at least significantly reduced with an associated improvement in the overall accuracy of the analysis. This improvement has been especially significant for external researchers using the analytical laboratory for sediment sample analysis as well as for biological samples. This acquisition, though relatively inexpensive,

has proven to be a frequently used and absolutely essential tool in our analytical laboratory operations.

Finally, the fifth item per Table 4 consists of a set of ten lead blankets obtained from Reactor Experiments, Inc. to minimize radiation dose levels around the radiography cave, outside the west cell door and other locations in the interest of ALARA as facility usage expands. Here the cost was nearly \$200 higher than quoted due to shipping such heavy items. This shielding has been important on the west side of the cell facing the fenced limited access lot, especially with implementation of the new 10 CFR Part 20 and consideration given to facility visitors. These lead blankets have also proven invaluable in limiting the background radiation levels around some materials occasionally used at the hot cave or NAAL as well as around UFTR ports when beams are used for transmission measurements or the radiography cave is in use. The key feature of their use is that they are an excellent response for ALARA considerations and are almost in continuous use around the facility. The only regret is that more of them were not obtained which we plan to do in the near future.

4.0 Final Grant Summary

Overall, the instrumentation obtained under the first year 1992-93 University Reactor Instrumentation Program grant assured that the goals of the program were well understood and met as well as possible at the level of support provided for the University of Florida Training Reactor facility. Though the initial grant support of \$21,000 provided toward the purchase of \$23,865 of proposed instrumentation certainly did not meet many of the facility's needs, the instrumentation items obtained and implemented did meet some critical needs and hence the goals

of the Program to support modernization and improvement of reactor facilities such as the UFTR within the academic community. Similarly, the instrumentation obtained under the second year 1993-94 University Reactor Instrumentation Program grant again met some of the critical needs for instrumentation support at the UFTR facility. Again, though the grant support of \$32,799 for proposed instrumentation at the same cost projection does not meet all of the facility's needs, it does assure continued facility viability and improvement in operations.

Certainly, reduction of forced unavailability of the reactor is the most obvious achievement of the University Reactor Instrumentation Program to date at the UFTR. Nevertheless, the ability to close out several expressed inspection concerns of the Nuclear Regulatory Commission with acquisition of the low level survey meter and the area radiation monitoring system is also very important. Most importantly, with modest cost sharing the facility has been able to continue and even accelerate the improvement and modernization of a facility, especially in the Neutron Activation Analysis Laboratory, that is used by nearly every post-secondary school in the State of Florida and several in other states, by dozens of departments within the University of Florida, and by several dozen high schools around the State of Florida on a regular basis. Better, more reliable service to such a broad-based user community can only support further growth in quality facility usage.

In the two grant years (1992-94) the University Reactor Instrumentation Program has supported instrumentation and equipment upgrades not only to improve reactor operations but also to improve existing facility/NAA Laboratory operations to support and facilitate reactor utilization. Indeed, one of the significant limitations in usage of the UFTR facility has been the throughput of the NAA Laboratory (NAAL). The fewer personnel and less equipment time used

in the NAAL, the more usage of the reactor that can be accommodated and the more users that can be accommodated in the laboratory facility. A number of NAAL improvements have been implemented with facility and University of Florida support including upgrading primary and support software packages for spectral analysis; nevertheless, in addition to the software, several additional improvements in the UFTR facility's existing NAA Laboratory capabilities were badly needed to increase productivity to support further expansion of usage, particularly among those intending to learn to use the laboratory facilities themselves. Acquisition and implementation of these items such as the freeze dryer with vacuum pump and the infrared moisture analyzer during this second year of the Instrumentation Program grant has significantly increased and improved quality throughput of the laboratory facility through decreased analysis time and/or personnel time commitments in the analysis facility. The result is more and higher quality reactor operations as well as improved and more reliable results for NAA Laboratory results including several surveillances required by UFTR technical specifications.

As newer, more reliable, state-of-the-art instrumentation is implemented at the UFTR facility, the message from the Department of Energy to the broad-based diverse community of users is that the mission of university reactors such as the University of Florida Training Reactor is regarded as important and should be supported. Since the technically trained and educated cadre produced by facilities such as the UFTR is needed throughout the nuclear energy industry wherever radiation or radioactivity is used, this message is most important for the technological future of this country. It is sincerely hoped that this University Reactor Instrumentation Program can be continued and its level of funding increased in future years to meet the program's stated objective of improving and modernizing operation of university reactors to an even higher degree.

5.0 References

W. G. Vernetson, "Proposal for Funding for the University of Florida Training Reactor through the U.S. Department of Energy University Reactor Instrumentation Program," May 1992.

W. G. Vernetson, "Proposal for Funding for the University of Florida Training Reactor through the U.S. Department of Energy University Reactor Instrumentation Program," March 1993.

Table 1

**TOTAL COST FOR PROPOSED UFTR FACILITY
INSTRUMENTATION AND EQUIPMENT UPGRADE
FOR 1992-93 GRANT YEAR**

I. Instrumentation/Equipment to Improve UFTR Operations	
1. Area Radiation Monitoring System (3 Channels)	\$ 15,800
2. Telescan Telescoping Survey Instrument (High Dose Rates)	3,095
3. Portable Low Level Ion Chamber Survey Instrument	990
4. Multipoint Temperature Recorder	3,980
5. Stack Effluent Monitoring System	39,750
6. Specialized Multitasking Computer for Airborne Contamination and Facility Tasking	7,475
7. Fiber Optics Extendable Boroscope	<u>10,780</u>
Subtotal	\$ 81,870
II. Equipment for Improvement of Existing Facility/ NAA Laboratory Operations	
1. Infrared Moisture Analyzer	3,595
2. Sample Freeze Dryer System (Console and Vacuum Pump)	5,556
3. Replacement HPGe Detector and Components (N-type)	<u>17,350</u>
Subtotal	\$ 26,501
III. Instrumentation and Equipment to Improve and Expand UFTR Facility Capabilities	
1. Detector Systems/Components	37,940
2. Computer/Display System	6,855
3. Interfacing Equipment	<u>2,585</u>
Subtotal	\$ 47,380
TOTAL	\$155,751
Cost Sharing Proposed (12.01%)	\$ <u>18,700</u>
REQUESTED SUPPORT	<u>\$137,051</u>

Table 2

**FINANCIAL RESULTS OF UFTR 1992-93
UNIVERSITY REACTOR INSTRUMENTATION GRANT**

Instrumentation Item	Proposal	Grant Allocation	Actual Cost	Charges to Grant	Cost Sharing
Area Radiation Monitoring System	\$15,800	\$13,903	\$14,439.00	\$12,705.40	\$1,733.60
Telescan Telescoping High Dose Rate Survey Instrument	\$ 3,095	\$ 2,724	\$ 3,445.00	\$ 3,031.38	\$ 413.62
Portable Low Level Survey Instrument	\$ 990	\$ 871	\$ 1,075.00	\$ 945.93	\$ 129.07
Multipoint Tempera- ture Recorder	\$ 3,980	\$ 3,502	\$ 4,039.05	\$ 3,554.11	\$ 484.94
TOTAL	\$23,865	\$21,000	\$22,998.12	\$20,236.82	\$2,766.23

Unused Portion of \$21,000 = \$763.18*

*The savings on actual cost of the area radiation monitor system left \$763.18 unused directly.
This amount was then used to cover part of the installation costs for the equipment.

Table 3

**TOTAL COST FOR PROPOSED UFTR FACILITY
INSTRUMENTATION AND EQUIPMENT UPGRADE
FOR 1993-94 GRANT YEAR**

I. Instrumentation/Equipment to Improve UFTR Operations	
1. Ultrasonic Flowmeter	\$ 4,600
2. Stack Effluent Monitoring System	39,750
3. Fiber Optics Extendable Boroscope	17,000
4. Emergency Survey Meter Package	3,680
5. Environmental Radiation Monitor	4,250
6. Micro-R Meter	1,460
7. Special Multitasking Computer Including Laser Printer	7,175
8. Liquid Scintillation Counter	<u>45,000</u>
Subtotal	\$ 122,915
II. Equipment for Improvement of Existing Facility/ NAA Laboratory Operations	
1. Sample Freeze Dryer System	
- Freeze Dryer Console (6 L)	\$ 4,435
- Vacuum Pump with Attachment	1,019
2. Infrared Moisture Analyzer	3,595
3. Portable Shielding Material (Lead Blankets @ \$215)	2,150
4. Replacement HPGe Detector and Electronic Components	21,650
5. Portable Shielding Material (Boral Sheets at \$331/ft.)	8,275
6. Neutron Radiography Shutter Materials	11,200
7. Neutron Radiograph/Radiography Facility Evaluation Devices	2,500
8. Prompt Gamma Spectroscopy System	<u>34,000</u>
Subtotal	\$ 88,824
III. Instrumentation and Equipment to Improve and Expand UFTR Facility Capabilities	
1. Upgraded PC-Based HPGe Detector System w/Integral Shield	44,850
2. NaI Gamma Spectroscopy System w/Microcomputer (est.)	<u>27,445</u>
Subtotal	\$ 72,295
TOTAL	\$284,034
Cost Sharing Proposed (13.38%)	<u>\$ 38,000</u>
REQUESTED SUPPORT	<u>\$246,034</u>

Table 4

**FINANCIAL RESULTS OF UFTR 1993-94
UNIVERSITY REACTOR INSTRUMENTATION GRANT**

Instrumentation Item	Proposal	Grant Allocation	Actual Cost	Charges to Grant	Status
Ultrasonic Flowmeter	\$ 4,600	\$ 4,600	\$ 4,625.00	\$ 4,625.00	Received and in Use
Remote Visual (Fiber Optics Extendable) Boroscope Inspection Package	\$17,000	\$17,000	\$16,931.20	\$16,931.20	Received and in Use
Sample Free Dryer System - Freeze Dryer Console (6L) - Vacuum Pump	\$ 4,435 \$ 1,019	\$ 4,435 \$ 1,019	\$ 5,155.78	\$ 5,155.78	Received and in Use
Infrared Moisture Analyzer	\$ 3,595	\$ 3,595	\$ 3,701.55	\$ 3,701.55	Received and in Use
Portable Shielding Material (10 Lead Blankets @ \$215)	\$ 2,150	\$ 2,150	\$ 2,340.00	\$ 2,340.00	Received and in Use
TOTAL	\$32,799	\$32,799	\$32,753.53	\$32,753.53	

Unused Portion of \$32,799 = \$45.47*

*The grant in 1993-94 provided the full cost in the proposal without cost sharing. Nevertheless, the actual cost was only \$45.47 below the proposal cost with the excess used to cover at least partially the implementation costs of some of the equipment listed to fully use the grant with the remainder of the implementation costs shared.