JP9950549

JAERI-Conf 99-006

Session 4-1

OPERATING THE ADVANCED TEST REACTOR IN TODAY'S ECONOMIC AND REGULATORY ENVIRONMENT

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ABSTRACT

The Advanced Test Reactor (ATR), located at the Idaho National Engineering and Environmental Laboratory, is the US Department of Energy's largest and most versatile test reactor. Base programs at ATR are planned well into the 21st century. The ATR and support facilities along with an overview of current programs will be reviewed, but the main focus of the presentation will be on the impact that today's economic and regulatory concerns have had on the operation of this test reactor.

Today's economic and regulatory concerns have demanded more work be completed at lower cost while increasing the margin of safety. By the beginning of the 1990s, federal budgets for research generally and particularly for nuclear research had decreased dramatically. Many national needs continued to require testing in the ATR; but demanded lower cost, increased efficiency, improved performance, and an increased margin of safety.

At the same time budgets were decreasing, there was an increase in regulatory compliance activity. The new standards imposed higher margins of safety. The new era of greater openness and higher safety standards complemented research demands to work safer, smarter and more efficiently.

Several changes were made at the ATR to meet the demands of the sponsors and public. Such changes included some workforce reductions, securing additional program sponsors, upgrading some facilities, dismantling other facilities, and implementing new safety programs.

1. INTRODUCTION

The end of the cold war era brought about significant changes in national programs. ATR's operating budget was reduced from $62M to $45M in four (4) years, even though there continued to be a strong need for much of the research being performed there. This was compounded by the fact that operating the reactor is a 100% effort, it is not possible to operate just part of the plant. In the same time period that these significant economic changes occurred, DOE operations became subject to higher safety standards and an agreement with the state of Idaho for waste cleanup. The message was clear, do more for less. Our complex was forced to take a hard look at areas that were less productive and even financially not justifiable. Maintenance was streamlined and prioritized. Facility upgrades had to be financially justified and show a return on investment such that the total costs decreased. Investing in new control systems proved successful. Modernizing the control system reduced the number of operator's needed and virtually eliminated unplanned outages due to spurious signals. DOE provided financial incentives in the operations contract for cost reductions, operating efficiencies safety, and new program development.

The operating contractor was faced with the challenge to cut costs, increase efficiency, and improve safety standards all at the same time. Cost cutting measures included reducing staff through attrition and an early retirement program. Cost reductions inevitably are demoralizing to employees. Several new lines of communication were established to explain actions so that changes could be made with minimal impact to the workforce.

2. NEW SAFETY BASIS

Safety requirements and public expectations have changed significantly since ATR was first built in the 1960s. Attention to safety has always been a top priority, but the atmosphere today is one of near zero tolerance for risks at nuclear facilities. DOE's response to the increased concern for safety was to require a completely new and upgraded Safety Analysis Report and Technical Safety Requirements. The TSR/SAR upgrade began in the late 80s and took many years to complete at a cost of $15M - $20M.

The effort proved to be larger than initially expected. A large team individuals with diverse backgrounds from all ATR organizations was assembled and dedicated to the new SAR throughout it's development and implementation. Personnel included experts from reactor operations, plant engineering, experiment planning, and reactor safety personnel. Many requirements were carefully reviewed and updated to today's safety standards. The interactions among the many requirements were evaluated and often required document modification to accommodate overlapping concerns.

The new TSR/SAR was approved by DOE in 1996, and implemented in March 1998. The entire ATR staff was trained on the new SAR prior to implementation. In order to implement the new SAR, many hundreds of other documents needed revision. All Experiment Safety Analysis documents were reissued to show compliance with the new SAR. Standing directives and maintenance work procedures were revised to assure compliance to the new standards. The change was a painful and difficult process, but was completed without interruption to ATR's operating schedule.

3. BENEFITS FROM THE ATR UFSAR UPGRADE AND IMPLEMENTATION

The primary benefit from the ATR Upgraded Final Safety Analysis Report (UFSAR) and Technical Specification Requirements (TSR) implementation is the real risk reduction in the operation of the facility. The risk to the public has deceased by approximately two orders of magnitude from the standpoint of a maximum credible accident at the facility. The previous maximum credible accident for the facility involved a complete core meltdown. Under the new TSR the maximum credible accident involves only localized fuel damage. The UFSAR rewrite effort was preceded by a level 3 Probabilistic Risk Assessment which included a complete facility walkdown and identification of areas where real risk reduction was possible through increased controls and facility modifications.

This decrease in risk was achieved by the following modifications to the facility Safety Limits, and to the Limiting Conditions for Operation (LCO):

- More restrictive safety limits for the low vessel differential pressure, low inlet pressure, and lobe power values.

- Plant Protective System – The LCO for the inlet-pressure subsystem was revised to increase the minimum inlet and outlet pressures.

- Inpile tube Draining Limits – The limit on the potential reactivity addition that results from draining an inpile tube has been reduced.

- Operation of Emergency Pumps – The emergency procedure to respond to a loss of flow accident was revised as well as heavy handling operations in the area over the emergency pumps. Additionally, auto-start capability was added to the emergency pumps.

- Power Generation Limits – Additional analysis was performed that now considers the effective plate power generation rather than the point power generation and also considers axial power changes. While the lobe power limits remain essentially unchanged, this new analysis will provide for the proper control of power peaking.

- Primary Coolant System (PCS) Leakage Rate – The large-break loss of coolant accident (LOCA) is shown to be beyond design basis by the addition of controls on the amount of leakage from the PCS system. Additional limits regarding leakage during normal operation and prior to start-up and walkdowns of the PCS are now established. Mitigation of the Loss of Heat Sink – The additional analysis showed that the coolant temperature needs to be maintained below 200° F during accident conditions. Controls are established to ensure that the coolant does not exceed 200° F.

- Canal Operations – Additional administrative controls are established which minimize the amount of damage from a crane failure during fuel movements. All cask movements are now required to be performed over an energy absorbing pad. Bulkheads are required to be in place in order to isolate irradiated fuel elements prior to cask handling operations.

- Irradiated Fuel in the Core during Outages – Additional administrative limits were established regarding the removal of fuel elements from the core or specific controls on outage activities to limit the potential for a LOCA.

4. COST SAVINGS AND DEVELOPING NEW BUSINESS

In the early 1990s, DOE's Naval Nuclear Propulsion Program consolidated their needs for ATR testing. Up to 1994, this program used pressurized water loops in all nine flux traps. Since that date the base program has used only five of the loops. Appropriately, emphasis was placed on ATR to reduce costs and secure other test sponsors and problems. Efficiency and plant reliability were increased as a result of several ATR upgrades, and the ATR New Business function was added to INEEL's contractor.

Initially the new business effort focused on contacting numerous potential new sponsors. Contact was made with organizations worldwide by all means possible. A series of ATR Users Conferences were held to acquaint the nuclear industry with ATR's new availability and capabilities. ATR's previous decades of silence were evident. Few organizations knew that ATR could be used by other than DOE sponsors. A prevailing perspective was that ATR was old and near its life's end. Quite the opposite was the case, and it took a few years to overcome this misperception.

Today approximately 20% of the ATR test space is used by new sponsors. Isotope production was privatized and the isotope production in ATR has doubled. New research programs at ATR include fusion materials testing, mixed oxide fuel testing to support weapons materials disposition, and testing in reduced enrichment fuels for research reactors. Work at ATR now includes not only US government programs, but also support for commercial and international programs.

Transitioning from a single sponsor to multiple sponsors is challenging and lessons are still being learned about satisfying a wider variety of demands on the facility and staff. The biggest challenge is establishing new and better communication lines across the many organizations involved in different programs. Since ATR has always operated with many different tests in the core, there has been a reasonable way to accommodate all new sponsors to date.

5. PUBLIC AWARENESS

A key part of ATR's response to increased scrutiny by the public has been a policy of openness and respect for their concerns. With the cold war behind us, more information about ATR programs can and has been made available in both technical and lay communications. A wide array of tour groups regularly visit the reactor including local citizens, student groups, environmental organizations, nuclear researchers, commercial interests, and foreign entities.

Even the most minor incidents are reported to and in the press. A video about the reactor was produced and has been widely distributed. Technical brochures, a CD, and a web page are maintained. We have noticed this constant effort to keep the public informed results in positive feedback and often provides useful dialogue with a wide variety of stakeholders.

6. CONTRACTING MECHANISM

The normal contractual method at national laboratories has long been the so called M&O (management and operations) contract. Under such a contract, a private company is responsible for the day to day activities at the laboratory. The ownership and largest share of the risks are borne by the government. While this arrangement is a good one for national research and development efforts, it does not provide a strong incentive for the contractor to operate to best business practices. The more recent DOE contracts for operating the INEEL have included incentives to motivate the contractor to operate the laboratory in a more businesslike fashion. The contractor is also held liable for more of the risks. Some examples of how this has worked well for ATR include incentives for increasing reactor operating efficiency, reducing radiation exposure, securing new business, and decreasing operating costs.

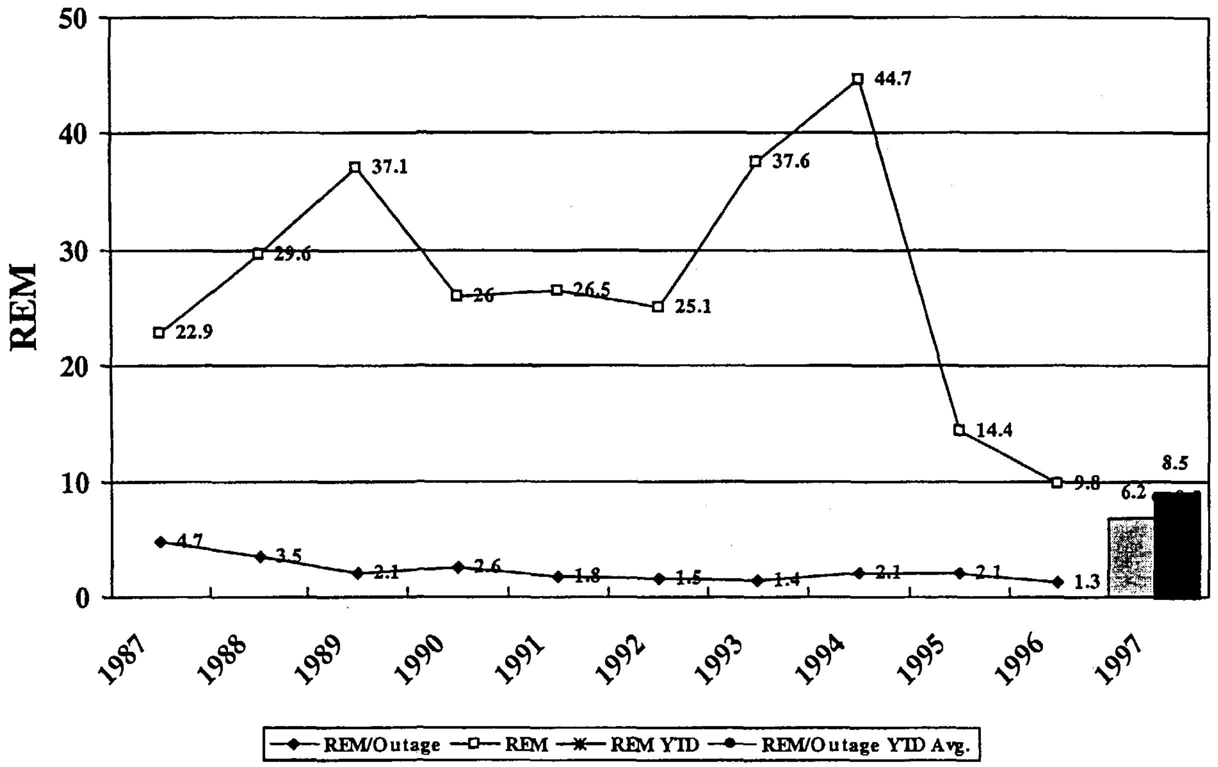
Improvements in plant operations are evident by a variety of measures. Unplanned reactor scrams have decreased nearly five fold, from double digits to single digits annually. Operating availability has been near 80%, a good number for a commercial reactor, let alone a test reactor. Efficiency (actual time available divided by planned time available) has risen to over 100%. Personnel exposure to radiation has dropped by more than 50%, providing safety and productivity do go hand in hand.

As these examples of contract incentives show, both the DOE and the contractor have benefited by the contract reforms over the last several years. We recommend such incentives as an effective way to improve business and operating practices at government facilities. We caution that incentives should be carefully formed to provide benefit to both parties.

7. CONCLUSION

Today, the nuclear industry must simultaneously meet demands for an even higher safety standard, increased public concerns for the environment, and better fiscal efficiencies. In the past decade, experience at INEEL's Advanced Test Reactor has demonstrated a number of approaches that meet the challenge. They include a tightening of technical safety requirements and administrative controls, eliminating unnecessary costs, pursuing additional new programs, increasing positive interactions with the public, and implementing contracting mechanisms that provide incentives to meet higher safety and operating goals. The experience at ATR demonstrates that not only can nuclear operations meet the demands of today's economic and regulatory environment, but that doing so can improve safety, reliability, and efficiency.

Radiation Exposure



Unplanned Reactor Scrams and Protective System Challenges