

ICEM07-7282

SUPPORT OF THE IRAQ NUCLEAR FACILITY DISMANTLEMENT AND DISPOSAL PROGRAM

Jeff J. Danneels / Sandia National Laboratories

Roger Coates / International Atomic Energy Agency

**John R. Cochran / Sandia National
Laboratories**

**Dr. Ronald K. Chesser / Center for
Environmental Radiation Studies
Texas Tech University**

**Dr. Carleton J. Phillips / Center
for Environmental Radiation
Studies
Texas Tech University**

**Dr. Brenda Rodgers / Center for Environmental
Radiation Studies
Texas Tech University**

ABSTRACT

Iraq's former nuclear facilities contain large quantities of radioactive materials and radioactive waste. The Iraq Nuclear Facility Dismantlement and Disposal Program (the Iraq NDs Program) is a new program to decontaminate and permanently dispose of radioactive wastes in Iraq. The NDs Program is led by the Government of Iraq, under International Atomic Energy Agency (IAEA) auspices, with guidance and assistance from a number of countries. The U.S. participants include Texas Tech University and Sandia National Laboratories. A number of activities are ongoing under the broad umbrella of the Iraq NDs Program: drafting a new nuclear law that will provide the legal basis for the cleanup and disposal activities; assembly and analysis of existing data; characterization of soil contamination; bringing Iraqi scientists to the world's largest symposium on radioactive waste management; touring U.S. government and private sector operating radwaste disposal facilities in the U.S., and hosting a planning workshop on the characterization and cleanup of the Al-Tuwaitha Nuclear Facility.

INTRODUCTION

The Iraq NDs Program is a new program to clean-up and permanently dispose of radioactively contaminated facilities and radioactive materials in Iraq. The NDs Program is led by the Government of Iraq, under IAEA auspices, with guidance

and assistance from a number of countries. Several U.S. participants, including Texas Tech University's Center for Environmental Radiation Studies (Texas Tech) and Sandia National Laboratories (Sandia) are assisting in the program. The Iraq NDs Program is helping to develop Iraq's entire nuclear facility dismantlement and radioactive waste disposal program, from laws/regulations through disposal of radioactive wastes at properly licensed facilities.

OVERVIEW

Large quantities of radioactive materials and waste associated with Iraq's former nuclear facilities at the Al Tuwaitha complex as well as other nuclear facilities may pose a significant health and safety hazard to workers and residents of the surrounding communities and to the environment. Nearly all of Iraq's former nuclear facilities were damaged and are now either known to be, or are potentially, radioactively contaminated. These former nuclear facilities are all problematic in some fashion and are in need of dismantlement and disposal. The precise extent of the radioactive contamination within these facilities is unknown at the present time.

The principal nuclear site in Iraq is Al Tuwaitha, the nuclear research centre which contains several facilities including research reactors and hot cells. The other key sites include the nearby Wardiya/Location C (a material/waste storage area) and Naddaf/Location B (a former spent fuel storage area), Adaya (rubble and equipment burial site), Qaim

(fertilizer plant and uranium extraction), Jesira (Uranium processing and waste storage), Rashdiya (centrifuge facility),

Ateer (uranium metal), and the Geopilot Plant (uranium extraction) and Tarmiya (enrichment plant).



All of these sites have some degree of contamination and require decommissioning and remediation in order to ensure radiological safety. Additionally, Iraq has never had regulations for the disposal of radioactive wastes, let alone a licensed radioactive waste disposal facility. A disposal facility is badly needed for safe disposal of current and future radioactive wastes.

In December 2004 the Government of Iraq requested IAEA assistance to determine the effort needed to implement this work and to set up plans and programmes for its delivery. An initiating meeting was convened in Vienna in February 2006 attended by the Iraqi Minister for Science and Technology and by representatives from sixteen countries, including the US and the European Commission. During the meeting the IAEA and the participants agreed to the broad scope of the assistance project. The project is coordinated through an IAEA's Waste Safety Section within the IAEA Division of Radiation, Transport and Waste Safety, with input and support from other IAEA Divisions and by many Member States. Funding for this phase is provided through the IAEA and through extra-budgetary funds. Sandia is supporting the Iraq NDs Project through the IAEA's and by providing training and tours of operating radwaste disposal facilities to Iraqi scientists to expose them to modern radwaste management practices, equipment, and professionals.

CURRENT APPROACH

Based on the output of the initial IAEA meeting in Vienna in February 2006, the IAEA support is being carried out in three phases:

- Phase 1: data collection and analysis of all available data,
- Phase 2: Sites and facilities assessment needed for developing decommissioning and remediation plans, and
- Phase 3: Performing the decommissioning and remediation field activities.

Sandia's current activities include supporting the IAEA and:

- Bringing Iraqi scientists to the U.S. to participate in the world's largest symposium on radioactive waste management. While at the symposium, Iraqi scientists met U.S. and international vendors that specialize in decontamination, decommissioning and waste disposal equipment.
- Providing training in fundamentals of project management and fundamentals of laws governing safe disposal of radwaste in America.
- Beginning the process of helping the Iraqis develop an overall project plan to coordinate the activities of multiple ministries in Iraq and multiple participants.
- Touring U.S. government and private sector, operating radwaste disposal facilities in Nevada and Utah.

Work completed or planned for 2007

Law and Regulation

Work is well advanced on drafting a new nuclear law that will provide the legal basis for the decommissioning licensing of the former nuclear complex. This law is being coordinated with a new law addressing the prohibition of Weapons of Mass Destruction. A set of supporting regulations is also being drafted covering detailed requirements for Radiation Protection, Decommissioning and Waste Management. This overall set of laws and regulations will replace the relevant legislation currently in existence within Iraq. This drafting work should be largely complete by the end of 2007. Then it will be up to the governing body in Iraq to implement the recommendations.

Characterisation Data Collection and Analysis

The current work is aiming to assemble, collate and assess all the data currently in existence, to assess and identify any data gaps and to prepare a plan for the collection of all the data necessary to underpin the Decommissioning Plan. The identification and justification of the necessary equipment, expertise and services to support this future work is included in this current activity, as is the assessment of a data management system which will support the documentation of the characterisation data based on facility mapping and also track the material, once decommissioning commences, through the waste management processes.

Scientists from Texas Tech University Center for Environmental Radiation Studies, working with Iraq Ministry of Science and Technology (MoST), IICSI, and Ukraine's International Radioecology Laboratory, have been actively evaluating the extent and type of radioactivity found in the Al Tuwaitha region since June 2005. Natural uranium contamination was found in 31 of 319 sample locations and three additional samples were found to contain radioactive waste and spillage from source materials. Maps of the contaminated sites have been turned over to the Minister of Science and Technology for his use in planning cleanup and dismantlement of facilities. The next phase of work in characterization will detail the types and amounts of radionuclides in the structures used in Iraq's former nuclear industry.

Prioritisation System

The project has developed the principles and outlined an application of a system to prioritise the sites and facilities in Iraq in order to facilitate the orderly and logical development of the Decommissioning Plan. The system contains both quantitative risk-based elements and wider judgemental modifying factors. The system is being populated with site/facility data, initially using 'best estimate' data but the quality will be upgraded as more substantive characterisation data becomes available.

Waste Management Strategy

International experience and current practice relevant to decommissioning waste management, material sentencing and clearance, treatment and packaging of waste, and waste disposal options are being reviewed. Emphasis is being given to understanding the strategic issues involved and the interaction between disposal requirements and decommissioning operations.

Waste Management'07 Symposium.

Sandia brought Iraqi scientists to the Waste Management'07 Symposium in Tucson, Arizona, USA. Bringing the scientists to the U.S. was very time-consuming and expensive because of the current security problems in Iraq, the expensive and difficult to purchase civilian airline tickets, the rapidly changing Iraqi passport requirement and the rapidly changing U.S. visa requirements.

Waste Management'07 is the world's largest symposium on radioactive waste management with over 2,200 attendees from more than 30 countries. Iraqi scientists attended a number of the 600 scientific and policy presentations in 80 topical areas including: decommissioning and decontamination of nuclear (non-power) facilities, perspectives and practices in packaging and transportation, innovations in low-level radioactive waste (LLW) management, and programmatic and regulatory issues in management for LLW.

In addition to the large number of presentations, the scientist talked to many of the 100 vendors providing hands-on displays and technical advice about their equipment and services. These vendors specialize in equipment to decontaminate, decommission and dispose of radioactive wastes. Ideas, pamphlets and brochures from the vendors provide Iraqis with sources of information and sources of equipment that can be used in Iraq.

Project Management Training

Training in fundamentals of project management and fundamentals of laws governing safe disposal of radioactive waste in America were provided. The training emphasized the importance and layout of a project management plan (PMP) that summarizes the goals, participants, roles and responsibilities, costs and schedules of a project. A draft Work Breakdown Structure, which is an organized system that divides work into manageable, interrelated tasks was prepared as part of the training. The primary performance objectives for licensing a safe land disposal facility in the U.S. for disposal of

radioactive wastes were also discussed. These performance objectives are: protection of the public, protection of the inadvertent human intruder and long-term site stability.

Toured Two Operating Radioactive Waste Disposal Facilities

Two operating radioactive waste disposal facilities in locations with climatic and geohydrologic conditions similar to those in Iraq were toured. The first facility is operated by the U.S. government and located on the U.S. Department of Energy's (DOE's) Nevada Test Site. This DOE facility is licensed for disposal of almost all types of LLW, including very high-specific activity LLW. The operating portion of the Area 5 Radioactive Waste Management Site (RWMS) covers 65 hectares and the facility only receives waste from U.S. government clients.



Over 370,000 cubic meters of radioactive waste have been disposed in the Area 5 RWMS since 1961. Wastes have been placed in unlined trenches and boreholes from 4 to 36 m below surface. Long-term safety is provided by the very thick, dry unsaturated zone (depth to groundwater is 235 m), low precipitation (130 mm per year), very high evaporation rates and isolation from population centers.

The second radioactive waste disposal facility is operated by EnergySolutions Inc. located near Clive, Utah. This private sector facility is licensed for disposal of the "least hazardous" class of LLW, called Class A LLW. Class A LLW will decay to levels that are safe against inadvertent human intrusion in 100 years.

Onsite waste treatment capabilities include: macro-encapsulation, liquid solidification, and metal shredding. At the EnergySolutions facility, wastes are placed in above ground level cells. Long-term safety is insured by limiting the inventory to Class A LLW, groundwater that is 10 m deep and twice as saline as sea water (not drinkable), limited precipitation rates (200 mm per year) and isolation from population centers.



Strategic Planning International Workshop on Al-Tuwaitha

The Texas Tech team hosted a strategic planning workshop at the Royal Scientific Society facility in Amman, Jordan. Financial assistance was provided by the Iraqi International Center for Science and Industry (IICSI, U. S. Department of State) and logistical assistance came from the U. S. Civilian Research and Development Foundation (CRDF). Attendees represented the U. S. Department of State Office of Nuclear Energy, Safety, and Security Affairs, Iraq Ministry of Science and Technology (including the Minister), Iraq Ministry of Environment (including the Minister), International Radioecology Laboratory in Ukraine; UK Ministry of Defense, the U.S. DOE Energy Attaché, U. S. Embassy Baghdad, U. S. Department of Defense (Office of the Secretary), and Iraq International Center for Science and Industry. M. David Kenagy (U.S. DOS) served as Workshop Host. The workshop goals were as follows.

- Develop a plan for moving forward with joint programmatic goals.
- Learn about MoST and the Ministry of Environment (MoEN) needs and identify ways in which the Texas Tech-IICSI-CRDF ((International Iraq Center for Science and Industry, Baghdad) team can help within context of the program.
- Formally integrate the original project team and ongoing scientific work into MoST and MoEN planning.
- Develop a plan for bringing the private sector (engineering/remediation) into the joint program.
- Request MoST and MoEN assistance in identifying personnel who can assist in supporting programmatic objectives (public health, for example).
- Determine ways in which Texas Tech University and partners (IICSI, CRDF) can develop educational opportunities in environmental toxicology, informatics, radiological studies, and engineering for Iraqi students.

On the final day of the workshop, the participants developed a set of recommended actions in support of the goals and strategic planning criteria. These recommendations are as follows.

Building characterization

- It is recommended to move forward with building characterizations using parallel approach of MoST & IRL. This will be proceeded by training and development of an acceptable protocol with the goal of providing analysis quickly and helping develop quality and certification of the MoST laboratories

Public health

- It is concluded that based on MoST and TTU-IRL analyses of contamination, no evacuation of people is deemed necessary at this time, but further data should be collected and, ideally, health monitoring be instituted. Swabs and joint analysis (MOST/IRL) of school buildings and studies of people is recommended.

- It is recommended that a health surveillance and services program be developed for radiation workers.

- It is requested that a summary report of historical data, assessments of human health (2003 study), and recommendations on future health assessments be prepared and submitted to the Ministers (MOST and MOEN) by Drs. Shubber & Ziyad on behalf of the IICSI team.

- It is recommended that MOST seek use of laboratory space and continuous electricity supply at the University of Baghdad or Naharain so that biological sampling/human studies can move forward. A team will be organized and trained so that blood, hair, and urine samples can be obtained when security permits.

- It is recommended that potential areas of human health risks (example: tanks containing radioactive liquid wastes) be identified and consideration be given to maintenance and inspection based on risk assessment.

Cooperation

- It is recommended that a network of communication be established between the international teams participating in the Tuwaitha Project. IICSI has offered to act as facilitator to ensure that the collaborative efforts are reported to MoST.

Skyline project

- It is recommended that the skyline project begin with the LAMA facility (confirmation that the facility is clean by MoST-IRL with parallel analyses as described above) while continuing forward with regulations and characterization of the 2 proposed contaminated sites with the continued guidance of IAEA.

- It is recommended that decommissioning plans for contaminated sites be developed and submitted to Iraqi regulatory bodies as part of the training and preparation process.

Education and training

- It is recommended that TTU explore the possibilities of establishing a link between researchers and project managers that allows exchange of ideas via videoconference and email at regular intervals

- It is recommended that a radiation safety program for workers be developed (a broad program to include FPS personnel at Tuwaitha)

- It is recommended that integrated training opportunities be promoted and expanded among ministries including MoHESR

- It is recommended that the “allocation of seats” program for graduate studies MoST and MoEN be developed by the MoHESR

- It is recommended that a joint committee between IICSI, MoST, MoEN, MoHESR and the Iraqi regulatory body be established

Future work programme

The balance of effort on the above workstreams is expected to change over the coming period as the issues come together in support of the development of the overall Decommissioning Plan. This will increasingly become the dominant component, requiring substantial input from the characterisation data and waste management workstreams. The prioritisation work will be subsumed as an integral part of the Plan.

Law and Regulation

Two further Technical Meetings are necessary to complete the drafting activity – including the development of Transport and Security Regulations. Emphasis will then be needed on ensuring that the Regulatory Body (currently the Iraq Radioactive Sources Regulatory Authority (IRSRA)) develops practical expertise in the application of the regulations, particularly regarding decommissioning and waste management activities new to Iraq. This will require visits/attachment to experienced regulators in other countries.

Characterisation Data

A very significant programme of work is anticipated in order to provide the necessary underpinning for the Decommissioning Plan. The hands-on work within Iraq will be funded locally, but significant external support, coaching and review will be required if the work is to be achieved in the necessary timeframe and at the necessary quality. Support for the review of external records (IAEA, supplier countries) is needed. In addition there will be some equipment purchase necessary to support the project, together with funding for the provision of the data management system.

Waste Management

The preliminary assessment of international waste management and disposal approaches obtained in the current

programme must be reviewed against the developing data on the Iraq waste management streams, and the appropriate waste management options assessed and approved. Whilst the work will be led by Iraqi personnel, it is essential that international expertise is available to guide and review this vital activity as the project moves towards an agreed waste management strategy. It is very likely that the early development of interim waste storage will greatly assist the project. Assessment of options for waste disposal (e.g., shallow land burial and intermediate-depth borehole disposal), including potential sites, will also be necessary at this stage of the project. Again, it is essential that international expertise be available to support these developments through Technical Meetings and relevant visits.

Decommissioning Plan

The development of the Decommissioning Plan is the central activity over the coming period, supported by the above workstreams. There is no experience or expertise within Iraq on which to base the development of the plan, and it will therefore be necessary to provide training, support and coaching in order to bring in the international experience. Preliminary development of the proposed project management organisation will be necessary, and the assessment and procurement of project management and work management systems must be undertaken. External advice on safety assessment, environmental assessment and operational safety control will need to be planned.

LONGER TERM PROJECT COMPLETION

The Decommissioning Plan will provide the platform for the development of the funding requirement for delivery of the project and for the overall project implementation plan.

Working within an international cooperation framework, which is expected to explore the potential mechanisms for Member State support and involvement in this work, the final phase (Phase 3) of the project will provide for the implementation of the demolition, decommissioning, remediation and waste management activities. These will no doubt take several years to come to completion.