

**TECHNICAL EVALUATION REPORT  
FOR A NEW  
SOURCE MATERIALS LICENSE SUC-1591**

**FOR  
R.M.D. OPERATIONS, LLC**

**PERFORMANCE-BASED, MULTISITE SERVICE PROVIDER  
LICENSE FOR THE REMOVAL OF URANIUM  
IN DRINKING WATER**

**WHEAT RIDGE, COLORADO**

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## EXECUTIVE SUMMARY

Over 30 years ago, the U.S. Congress enacted the Safe Drinking Water Act (SDWA). Regulations promulgated pursuant to the SDWA impose specific requirements on the levels of contaminants (including uranium) that may be present in public drinking water sources. In 1990, the U.S. Environmental Protection Agency (EPA) proposed a rule mandating that the maximum contaminant levels (MCLs) of uranium in drinking water sources be limited to 20 micrograms/liter ( $\mu\text{g/L}$ ) or 20 parts per billion (ppb). In 2000, EPA promulgated a final uranium MCL of 30  $\mu\text{g/L}$  or 30 ppb and imposed strict deadlines for compliance. The EPA rule requires that water treatment facilities (now estimated to be between 1000 and 2000) comply with these new requirements by 2007.

Certain technologies that can be used to remove uranium may result in (1) the water treatment facility possessing a quantity of source material<sup>1</sup> (i.e., uranium) that exceeds 0.05 percent by weight uranium, and (2) the water treatment facility possessing greater than 15 pounds of uranium in a very short period of time. A water treatment facility possessing such amounts of uranium, and located in a non-Agreement State, will need a license from the U.S. Nuclear Regulatory Commission (NRC) to possess uranium and will have limited options for its disposal.

In response to this new MCL, R.M.D. Operations, LLC (RMD) submitted a source material license application to the NRC. Under its license, RMD plans to offer a water treatment program to remove uranium from community water systems (CWSs). The program involves storing uranium residuals in RMD's self-contained uranium removal system (URS), and disposing of such uranium residuals in properly permitted or licensed facilities to assure the safe and secure final disposition of these materials. Final disposition of uranium residuals will be either as a waste or as an alternate feed for processing at uranium recovery facilities authorized to accept such material for introduction into the commercial nuclear fuel cycle as "yellowcake." The RMD uranium water treatment program may enable CWSs to safely and cost-efficiently remove uranium from drinking water sources to comply with the SDWA uranium MCL without the need to procure relevant radioactive materials handling expertise. The RMD program may also allow CWSs to permanently remove the uranium from their respective environments.

The NRC has regulatory control and oversight of source material. As an NRC licensee, RMD will have ownership and/or control of its URS, its operation, and all licensed materials contained therein, including treatment media and licensable uranium source material removed from the treated water.

The NRC's licensing action addresses an issue (i.e., CWS compliance with the EPA drinking water standards) on the national, state, and local level. Many CWSs requiring uranium water treatment are expected to be located in Agreement States. RMD requested that the NRC staff facilitate the involvement of Agreement States in the licensing process to streamline the potential for issuance of similarly formatted Agreement State licenses. As a result, the NRC's draft environmental assessment (NRC, 2006a) was sent to Agreement and non-Agreement States for their review and comment before issuance of the final environmental assessment (NRC, 2006b).

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<sup>1</sup>Source material is defined in Title 10, Section 40.4, "Definitions," of the *Code of Federal Regulations* (10 CFR 40.4 as "(1) uranium or thorium, or any combination thereof, in any physical or chemical form, or (2) ores which contain by weight 0.05 percent or more of uranium, thorium or any combination thereof."

RMD has proposed to create a Safety and Environmental Review Panel (SERP) to compile all relevant information for the CWSs that choose to install RMD's water treatment system. The SERP will ensure that such installations are in accordance with the safety and environmental evaluations performed by the NRC in issuing RMD its license.

RMD presented its license application in three parts—(1) a license application letter describing the proposed format of the requested license, (2) an Environmental Report (ER) describing the proposed RMD water treatment program and the environmental analyses of its potential occupational and public health and safety impacts and relevant alternatives, and (3) a safety analysis presenting the generic overview of the RMD water treatment operations under its proposed license (RMD, 2005a; RMD, 2005b; RMD, 2005c).

This technical evaluation report documents the NRC staff's completed technical and safety review of the RMD license application for a performance-based, multisite service provider license. The NRC staff concludes that the requirements of 10 CFR Part 40, "Domestic Licensing of Source Material," and other applicable criteria have been satisfied. Therefore, the NRC staff finds that the issuance of a performance-based, multisite service provider license to RMD containing the license conditions listed and pursuant to the statements contained in the license application will not be inimical to the common defense or security or to public health and safety. The NRC staff further concludes that RMD has provided adequate assurances that applicable NRC requirements will be satisfied.

# 1.0 INTRODUCTION

## 1.1 Background

Over 30 years ago, the U.S. Congress enacted the Safe Drinking Water Act (SDWA). Regulations promulgated pursuant to the SDWA impose specific requirements on the levels of contaminants (including uranium) that may be present in public drinking water sources. In 1990, the U.S. Environmental Protection Agency (EPA) proposed a rule mandating that the maximum contaminant levels (MCLs) of uranium in drinking water sources be limited to 20 micrograms/liter ( $\mu\text{g/L}$ ) or 20 parts per billion (ppb). In 2000, EPA promulgated a final uranium MCL of 30  $\mu\text{g/L}$  or 30 ppb and imposed strict deadlines for compliance. The EPA rule requires that water treatment facilities (now estimated to be between 1000 and 2000) comply with these new requirements by 2007.

Certain technologies that can be used to remove uranium may result in (1) the water treatment facility possessing a quantity of source material<sup>2</sup> (i.e., uranium) that exceeds 0.05 percent uranium, and (2) the water treatment facility possessing greater than 15 pounds of uranium in a very short period of time. If this should happen, water treatment facilities located in non-Agreement States will require a license from the U.S. Nuclear Regulatory Commission (NRC) to possess uranium and will have limited options for its disposal. Requirements for licensable source material levels are set forth at Title 10, part 40, of the *Code of Federal Regulations* (10 CFR).

In response to the new MCL for uranium, R.M.D. Operations, LLC (RMD)<sup>3</sup> submitted a source material license application to the NRC. Under its license, RMD plans to offer a water treatment program to remove uranium from community water systems (CWSs). The program involves storing uranium residuals in RMD's self-contained uranium removal system (URS), and disposing of such uranium residuals in properly permitted or licensed facilities to assure the safe and secure final disposition of these materials. Final disposition of uranium residuals will be either as a waste or as an alternate feed for processing at uranium recovery facilities authorized to accept such material for introduction into the commercial nuclear fuel cycle as "yellowcake." The RMD uranium water treatment program may enable CWSs to safely and cost-efficiently remove uranium from drinking water sources to comply with the SDWA uranium MCL without the need to procure relevant radioactive materials handling expertise. The RMD program may also allow CWSs to permanently remove the uranium from their respective environments.

## 1.2 RMD Application

RMD's September 27, 2005, license application discussed its proposed water treatment service that would bring CWSs into compliance with the new uranium in drinking water MCL promulgated by EPA under the SDWA. The proposed uranium water treatment program involves the installation of RMD's URS at CWS facilities. The URS uses ion exchange (IX)

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<sup>2</sup>Title 10, Section 40.4, "Definitions," of the *Code of Federal Regulations* (10 CFR 40.4) defines source material as "(1) uranium or thorium, or any combination thereof, in any physical or chemical form, or (2) ores which contain by weight 0.05 percent or more of uranium, thorium or any combination thereof."

<sup>3</sup>R.M.D. Operations, LLC is located at 9500 W. 49<sup>th</sup> Avenue, Suite D-100, Wheat Ridge, Colorado 80033

treatment technology to remove natural uranium from drinking water sources by capturing it on a treatment media. When the treatment media is fully loaded with uranium, RMD will remove it from the URS and ship it via U.S. Department of Transportation (DOT)-approved transport vehicles and containers to a properly licensed and/or permitted facility for final disposition. Final disposition of such treatment media includes either direct disposal as a waste or, more likely, processing as an alternate feed to recover the uranium content for introduction into the commercial nuclear fuel cycle. This technical evaluation report (TER) documents the NRC staff's technical and safety review of the RMD license application.

RMD currently operates a URS at the Fox Run Water Company located near Petersburg, Virginia. Even though the uranium concentrated in the URS does not exceed NRC-licensable levels or general license limits, RMD intends for the Fox Run Water Company to be the first facility registered under its proposed performance-based, multisite service provider license. RMD attached a short description of the relevant information regarding the Fox Run Water Company to its license application.

### **1.3 Description of the Proposed Action**

The RMD performance-based, multisite service provider materials license will authorize the commercial operation of its uranium water treatment program, including the installation of URSs at CWS facilities located in non-Agreement States who enter into contracts with RMD. Uranium will be extracted from CWS drinking water sources using treatment media in self-contained treatment vessels similar to that used by *in situ* leach (ISL) uranium recovery licensees, and the uranium will be concentrated and stored on the treatment media. When fully loaded, the treatment media will be removed from the URS and transferred to DOT-approved vehicles and containers for transport to properly licensed facilities for final disposition. This treatment media will be either processed as an alternate feed material at a licensed uranium recovery facility or directly disposed of as a waste at a properly licensed and/or permitted disposal facility.

The NRC license will allow RMD to add CWSs to its license by a registration process that will not require the issuance of license amendments by the NRC. RMD has proposed to create a Safety and Environmental Review Panel (SERP) to compile all relevant information for the CWSs that choose to install RMD's water treatment system. The SERP will ensure that such installations are in accordance with the safety and environmental evaluations performed by the NRC in issuing RMD its license. The SERP will document its decisions to the NRC. The URS at each CWS site will be subject to NRC inspection.

### **1.4 Review Scope**

Consistent with the requirements of 10 CFR 40.32, "General Requirements for Issuance of Specific Licenses," and 10 CFR 40.35, "Conditions of Specific Licenses Issued Pursuant to § 40.34," the NRC can issue RMD a service provider license if, among other things, the following criteria are met:

- The application is for a purpose authorized by the Atomic Energy Act.
- The applicant is qualified by reason of training and experience to use the source material for the purpose requested in such a manner as to protect health and minimize danger to life or property.

- The applicant's proposed equipment, facilities, and procedures are adequate to protect health and minimize danger to life or property.
- The issuance of the license will not be inimical to the common defense and security or to the health and safety of the public.

To determine whether RMD has met the above requirements, and as conditions for approval of the license request, the NRC staff evaluated the safety and environmental aspects of the license application, including determining whether RMD is in compliance with the specific requirements and objectives set forth in 10 CFR Part 40, "Domestic Licensing of Source Material," and 10 CFR Part 20, "Standards for Protection Against Radiation." The staff conducted its evaluation, as described in the sections below, in accordance with the general guidance provided in NUREG-1520 (NRC, 2002a). The NRC staff also referenced, in part, NUREG-1569 (NRC, 2003) as a guide.

This TER documents the NRC staff's technical and safety review of the relevant issues associated with the operation of uranium water treatment systems at multiple geographic locations across the United States. Any RMD commitments made in its license application and other licensing documents are enforceable regardless of whether this TER restates them. The TER safety review focuses on those aspects of radiation protection discussed in the license application.

The NRC has prepared an environmental assessment (EA) to address the environmental impacts of the proposed action (NRC, 2006b). The RMD ER presents the licensee's evaluation of the health, safety, and environmental impacts, as well as the measures to mitigate such impacts. The NRC EA also discusses these impacts in detail. Safety and environmental considerations found to be important by the NRC staff are included as conditions in the NRC license.

The applicant has acceptably described its concept to provide water treatment services to CWSs. Specifically, the applicant has adequately described the following:

- corporate entities involved
- the proposed facility (a generic CWS)
- the issue of source material ownership
- potable water flow rates and uranium oxide (U<sub>3</sub>O<sub>8</sub>) content
- the RMD proposed extraction method and recovery process
- operating plans, design throughput, and annual U<sub>3</sub>O<sub>8</sub> production
- waste management and disposal plans
- decommissioning
- surety arrangements covering facility decommissioning

## 1.5 Findings

Based on the information provided in the application and the detailed review conducted of the summary of RMD's proposed activities at CWS facilities, the staff concludes that the proposed RMD activities are acceptable and are in compliance with 10 CFR 40.31, "Application for Specific License," which describes the general requirements for the issuance of a specific



license, and 10 CFR 51.45, "Environmental Report," which requires a description of the proposed action sufficient to allow the staff to evaluate the impacts on the affected environment.

Section 2.3.1 of the ER acceptably describes the URS and its components, uranium removal processes, transport vehicles and containers, and other relevant requirements. To ensure that the RMD uranium water treatment program remains within the bounds specified in the Environmental Report, the NRC will impose the following license conditions (LCs):

- LC The R.M.D. Operations, LLC uranium water treatment program, including operation of its uranium removal system, media exchanges, and final disposition pathways, shall operate as specified in the R.M.D. Operations, LLC Environmental Report dated September 27, 2005, except where superseded by licensed conditions contained in this license or approved by the NRC. Whenever the words "will" or "shall" are used in the above referenced documents, it shall denote a requirement.
  
- LC R.M.D. Operations, LLC shall contractually possess the uranium source material contained within the uranium removal system, including the ion exchange vessels. R.M.D. Operations, LLC may lease space from the community water system to house the uranium removal system. If a uranium removal system is sold or otherwise transferred to the community water system by R.M.D. Operations, LLC, R.M.D. Operations, LLC shall execute a contract with the community water system to lease the uranium removal system to retain possession of the source material. If the uranium removal system is not leased back to R.M.D. Operations, LLC, the community water system will be required to obtain an NRC specific license or comply with another future regulatory option, such as a general license, promulgated or endorsed by the NRC.

## 2.0 SITE CHARACTERIZATION

This section of the TER presents the range of site sizes and conditions expected at CWSs where the URS may be installed. This section defines the conditions at typical water treatment facilities to enable the RMD uranium water treatment program to be evaluated.

### 2.1 Generic Site and/or Facility Description

The RMD uranium water treatment system, including the URS, will be located at existing CWS water treatment facilities or at newly constructed CWS facilities adjacent to locally permitted drinking water wells where water treatment for uranium removal is necessary. The CWS facilities may be located in urban, suburban, or rural areas and in various climates throughout the United States.

Typically, CWS water treatment facilities vary in size and dimensions based on the type of water treatment operations performed and the volume of water supplied. In all cases, for both old and new well sites, RMD will deliver to, and install, the URS in an existing water treatment facility, typically at the site of the water well(s) and well house(s). The facility can also be a primary distribution point where water from multiple wells is combined before entering the municipal distribution system. In general, potential adverse land use impacts by the existing CWS water treatment facility will likely have been assessed previously and new assessments may not be necessary. The CWS will own or control the facility site and whatever land disturbance that the URS requires will have taken place before the system arrives on site for installation.

Features and structures on the facility site typically will include the water well(s), well house(s), and water storage tanks. Even at a site that has a storage tank(s), the water may, at times, be pumped directly from the well house into the distribution system, precluding the use of these storage tanks. The well house contains the local control equipment and instrumentation for the water well(s) and existing water treatment activities (e.g., chloride and fluoride additions, sand removal). Those treatment activities associated with smaller URSs could be placed in structures the size of small storage buildings (i.e., 400 to 500 square feet). A small URS is currently (as of October 2006) operating at a well site owned by the Fox Run Water Company near Petersburg, Virginia. This is an 80- to 100-gallon per minute (gpm) system with a uranium concentration in drinking water of approximately 80 µg/L. In this case, the URS is contained within a new, separate frame building. Figure 2-2 of the ER provides photos of both the URS and the building that houses it. The well's original treatment equipment is located in a building of similar size.

The treatment room/building for larger URSs could range in size from 1200 to 2000 square feet, potentially requiring a new addition to an existing well house. Figure 2-3 in the ER presents a generic layout of a well house for a large URS, handling up to approximately 1500 gpm. This URS would require only one large treatment vessel, which would be up to approximately 15 feet in diameter. Figure 2-4 in the ER presents a generic layout of a well house for a system larger than 1500 gpm, which would require two treatment vessels. Operation of most well houses generally is automated and an operator's constant presence at the facility is not required. The URS will be operating in an area that has restricted access and will require limited work tasks in the immediate vicinity of the treatment vessel. RMD has set an operating upper boundary for URSs of no greater than 3000 gpm to be evaluated in the license application.

These water supply sites may vary in size, depending on the capacity of the supply system, from less than an acre of land for a small 100-gpm well with relatively small storage tanks located directly on the ground to up to several acres for a large 1,000-gpm well or more with a 500,000-gallon water tower located on the site. The general location of these facilities can range from a rural area, to a separate lot in a residential setting within a city, to a separate portion of a large municipal complex. Typically, the URS will be located within an enclosed building, such as a well house as described above. On rare occasions in which inclement weather is not a major concern (e.g., southern California), the URS may be located on a pad in the open or under a covered structure with open sides.

In general, the water treatment facility, which is an important component of the CWS, will be secured, regardless of whether radionuclides must be removed from the water. At a minimum, the well houses will be locked. Many sites, although not all, will also be secured with locked fences. If the URS is located in the open, outside of a building (an atypical situation), the NRC will require that such treatment sites be fenced and locked when unattended.

### **2.1.1 Findings**

The staff finds the generic site and/or facility description to be acceptable.

## **2.2 Historic and Cultural Resources**

The construction of new buildings for containment of the URS may require an assessment of historic and cultural resources, but any such impacts will likely be negligible. The NRC expects that when CWSs and URSs are located in and around historic towns and features, building permits, in addition to a review by a local architectural review board or similar type governing body, will be required. The applicant would likely address historic and cultural resource issues at that time.

### **2.2.1 Findings**

To ensure that the RMD uranium water treatment program operates within the bounds of the findings in the EA, the NRC will require the following license condition:

- LC R.M.D. Operations, LLC will consult with State and/or local historic preservation officers or similar governing body before beginning construction related to, or the use of, a uranium removal system that is located outside of, or away from, existing community water system structures.

## **2.3 Land Use, Geology, and Soils**

The RMD URSs will be sited at either existing CWS facilities or in small utility-type sheds near CWS wellheads. For URSs sited at or within CWS structures, no effects on land use, geology, or soils are expected because no infrastructure construction will be required. For URSs sited near wellheads or outside the CWS existing structures, minor land disturbance can be expected and will be primarily centered around initial, small-scale grading and site construction. Land disturbance is expected to be less than 10,000 square feet in most instances because the flow

rate of the URS cannot exceed 3000 gpm. Many communities will likely require a building permit for the construction or placement of a utility-type shed, and they may require erosion controls as part of the building permit process for land disturbance activities. The minor land disturbance associated with construction will have little effect on geology and soils; any land disturbance is not expected to extend beyond minor site grading and shallow foundation footings for the shed and minor trenching for electrical and plumbing utilities.

### **2.3.1 Findings**

The staff finds the description of the land use, geology, and soils surrounding water treatment facilities to be acceptable.

## **2.4 Transportation**

The roads used for the transportation of the URS and resulting source material will be the same as those currently used by the CWS for receiving supplies for typical water treatment operations (e.g., treatment chemicals, maintenance equipment, waste products). Existing paved highways, secondary roads, and local roads, as well as gravel or dirt roads, will likely be used to access the URS. The URS is not expected to add significantly to the usage of these roads. For larger CWSs, inspections of the URS will be done by CWS employees trained in radiation protection and by RMD. These inspections are likely to be done in conjunction with normal inspections of equipment already contained within the CWS and thus require no additional trips. For URSs located at wellheads, regular inspections will require a slight increase in additional trips to the wellhead and the URS. These additional trips for inspections and regular maintenance are expected to cause only minor impacts to existing roads.

Resin or “exchanged media” loaded with uranium from the IX vessel will be transported to either a permitted or licensed disposal facility or a licensed uranium mill for use as alternate feed material. Material will be transported in either DOT-approved tanker trucks or large, polyfabric “super sacks” that have been approved for transport of radioactive material. RMD expects 200 trips per year per 1000 facilities served. Based on accident statistics and an average nationwide travel distance of 1000 miles to the site of final disposition, RMD expects that an accident involving spent treatment media shipment will occur no more than once every 2.5 years. These accidents statistics do not approximate the severity of the accident, which could range from severe to relatively minor (i.e., a fender bender).

### **2.4.1 Findings**

The staff finds the description of roads surrounding CWSs and the method of transportation of the URS and spent IX media to be acceptable.

## **2.5 Water Resources**

The number of ground-water wells are not expected to change as a result of the need to remove uranium from drinking water. The same ground water that is currently in use is expected to be used in concert with the URS.

The URS removes uranium from ground water in self-contained IX vessels. When the IX exchange media is near capacity, it is removed and transported off the CWS site. Spills or

releases of the IX media, and the uranium adhered to it, could be one possible effect on water resources. If a spill or release were to occur, surface spillage could easily be cleaned up with the tools RMD provided to the CWS, so as long as the material was contained within the treatment shed, CWS facility, or even on the ground. If the URS is housed in a treatment shed or within a CWS facility that has a floor drain, sump, or similar water catchment that leads to a sanitary sewer, storm sewer, or drain field, a major spill from the URS could cause exchange media and uranium source material to enter a sanitary sewer, storm sewer, or a drain field and directly affect water resources. If a possible direct outlet to a storm sewer, sanitary sewer, or drain field exists at the CWS, the URS can be designed with a secondary containment system to protect against a release of radionuclides that could affect water resources.

The locations of CWS systems vary and it is possible that a CWS will be located on the 100-year flood plain. If the CWS primary treatment facility is located on the 100-year flood plain, the URS should be protected from the effects of flooding. However, locating the URS in the 100-year flood plain may not compromise public health and safety or environmental protection. Therefore, RMD will be required to have approval by the SERP that public health and safety and the environment are protected and obtain NRC approval before locating the URS on the 100-year flood plain. This does not preclude the requirement for RMD to obtain other necessary state and local permits required for construction or installation of the URS on the 100-year flood plain.

### **2.5.1 Findings**

The effects of the RMD URS on water resources are expected to be small and, therefore, acceptable. However, to address the unlikely event that a spill should occur and affect the water resources near the CWS and to ensure that the RMD uranium water treatment program operates within the bounds of the findings in the EA, the NRC will require the following license condition:

- LC If a possible direct outlet to storm sewers, sanitary sewers, or drain field exists at the community water system where the uranium removal system will be operated, the uranium removal system will be designed with a secondary containment system to protect against a release of any media containing source material that could affect water resources. The uranium removal system shall not be located on the 100-year flood plain unless approved by the R.M.D. Operations, LLC Safety and Environmental Review Panel and the NRC.

### **2.6 Ecological Resources**

Ecological resources could be affected if a major onsite spill were to occur, but such a spill is unlikely. Major spills should be contained by the secondary containment system proposed by RMD for the URS. Minor spills, because of the inert nature of the material, are not expected to affect ecological resources. Ecological resources could be affected by transportation spills, but these accidents are unlikely and should be easy to clean up.

### **2.6.1 Findings**

To ensure that the RMD uranium water treatment program operates within the bounds of the findings in the EA, the NRC will require the following license condition:

- LC R.M.D. Operations, LLC will consult with Federal or State fish and wildlife agencies to identify potential endangered or threatened species before beginning construction related to, or the use of, a uranium removal system that is located outside of, or away from, existing community water system structures.

### **2.7 Meteorology and Air Quality**

The RMD URS is designed to be self-contained, thereby limiting, if not eliminating, potential public or occupational exposure to airborne uranium residuals or other particulates.

#### **2.7.1 Findings**

The staff finds the description of the meteorology and air quality related to water treatment facilities to be acceptable.

### **2.8 Public and Occupational Health**

#### **2.8.1 Public and Occupational Exposures**

A CWS may be located in an urban, suburban, or rural area of the country. The URS will be kept inside of a shed or within an existing building of the CWS to restrict public access. A slight chance of public exposure exists if a person were to break into the shed or CWS facility housing the URS. The total radiological exposure associated with this scenario is expected to be minimal. The exposure resulting from contact with the IX vessel should be no greater than 0.3 millirem per hour (mrem/hr), which equates to an exposure level of 7.2 mrem over a 24-hour period. However, this exposure rate assumes that the individual remains in physical contact with the vessel for a full 24 hours. Because the URS will probably be inspected on a daily basis, it is unlikely that anyone breaking into a facility housing the URS would be exposed longer than 24 hours or at an exposure rate greater than 7.2 mrem, which is considered to be a minor exposure. The calculated on contact exposure in a 24-hour period is equivalent to about 3 chest x-rays. However, if the individual were in the building for a 24-hour period, but remained 30 centimeters away from the vessel (a more likely break-in scenario), the exposure rate would be 0.003 mrem/hr, which equates to an exposure level of 0.072 mrem in a 24-hour period, which is considered to be a very minor exposure. The chart below is a comparison of radiation doses from various sources that puts the potential dose in perspective to other natural and manmade sources.

In the unlikely event of a major spill, RMD will initiate emergency response procedures designed to safely contain and remediate the release. In facility areas with drains or other discharge points to the environment, RMD must provide secondary containment. In facility areas with no discharge points, RMD will ensure that a major spill cannot leave the facility and be accessed by the public. The NRC considers the small risk to the public to be acceptable because the URS will provide a benefit by reducing uranium concentrations from above the

MCL to below the MCL, thus protecting the public from ingesting uranium in its drinking water. In addition, the URS will also remove uranium from the community as the uranium source material is removed and disposed of at a properly permitted or licensed facility.

For occupational health considerations and requirements and to satisfy the radiation protection and as low as is reasonably achievable (ALARA) requirements of 10 CFR Part 20, RMD has described a radiation protection program. This program details the roles and responsibilities of the corporate radiation safety officer (CRSO), RMD system specialists, and local utility operators working in the radioactive materials area. The program details the general rules for the safe possession of licensed material and area and personnel monitoring. RMD has calculated the potential annual dose to the local utility operators to be approximately 0.1 millirem per year (mrem/yr) assuming an operator spends 100 hours per year performing tasks at approximately 1 meter from the IX vessel at a maximum uranium load producing a 0.3 mrem/hr dose rate at the surface.

Inhalation hazards for workers are expected to be low. Yellowcake dust is a primary concern; it is unlikely that moist uranium-laden resin beads will become airborne because they are significantly larger than yellowcake dust.

RMD has calculated direct radiation doses from a spill cleanup for skin dose, inhalation dose, and ingestion dose. RMD estimated the skin dose rate to be 3.69 mrem/hr and the estimated ingestion dose to be 2.1 mrem. The estimated inhalation dose rate was considered negligible since the treatment media particles, at approximately 600 µm in diameter, are too large to be respirable and are unlikely to remain suspended for any significant period of time.

**2.8.1.1 Findings**

The NRC expects the health impacts related to public and occupational exposures to be minimal. The RMD system specialists, CWS managers, and CWS operators are not expected to receive an annual radiation dose anywhere near the individual monitoring threshold of 500 mrem/yr for adults or 100 mrem/yr for children or pregnant women prescribed in 10 CFR 20.1502, "Conditions Requiring Individual

<b>Comparison of Radiation Doses from Various Sources</b>	
Radiation Source Dose to an Individual	
From natural sources (cosmic, terrestrial, radon)	300 mrem/yr
From manmade sources (medical, consumer products, fallout)	60 mrem/yr
Annual background radiation—U.S. average total	360 mrem/yr
Daily background radiation—U.S. average	1 mrem/d
Increase in cosmic radiation dose from moving to a higher altitude, such as from Miami, Florida, to Denver, Colorado	25 mrem/yr
Chest x-ray	10 mrem
U.S. transcontinental flight (5 hours)	2.5 mrem
Dose from naturally occurring radioactive material in agricultural fertilizer—U.S. average	1 to 2 mrem/yr
Dose to worker from a loaded IX vessel for 100 hours	.1 mrem

Source: National Council on Radiation Protection and Measurements (NCRP, 1987)

Monitoring of External and Internal Occupational Dose Rate.” RMD has estimated, and the staff has confirmed at the Fox Run Water Company pilot project, that maximum dose rates at the sides of the tanks should be between 0.2 and 0.3 mrem/hr and less than .003 mrem/hr at 30 centimeters away from the tanks. The staff has judged the RMD estimates of the time operators will spend in proximity of the vessels to be reasonable. That working time would result in a maximum exposure of 3 mrem/yr. This is a small fraction of the 360 mrem/yr from background radiation an individual receives from natural sources. Therefore, the staff finds the potential exposure to be reasonable.

## 2.8.2 Accidents

The bounding worst-case accident for operations involving the URS was considered to be a transportation spill of fully loaded resin beads. For the sake of conservatism in calculating the potential dose to a transportation spill cleanup worker, RMD assumed that each accident would result in a spill releasing spent treatment media in the immediate vicinity of the accident site. Because the resin would be shipped moist, RMD projected that none of the released material would be dispersed into the atmosphere. Further, because the uranium would be tightly bound to the treatment media, it would not become soluble. Any dispersion of the spent treatment media via water could only be a physical and not a chemical process. Thus, potential adverse impacts to waterways would be minimal in the unlikely event that the treatment media could reach one.

To estimate dose to cleanup workers and the general public, RMD made the following assumptions:

- Loading on the spent treatment media is 60,000 parts per million (ppm), which is equal to a resin concentration of 54,000 picocuries per gram (pCi/g) of natural uranium.
- The treatment media will contain the immediate decay products of natural uranium, including uranium-238, thorium-234, protactinium-234m, protactinium-234, uranium-234, uranium-235, and thorium-231.
- Transport tankers, up to a 1000-cubic-foot capacity, may contain up to 20 tons of spent treatment media.
- Doses are calculated assuming an infinite plane of spilled material, which is a maximizing assumption.

The dose rate at the surface of a spill with a resin concentration of natural uranium of 54,000 pCi/g will be approximately 0.37 mrem/hr. If a cleanup were to require 8 hours of effort, the cleanup worker would receive less than 3 mrem of exposure within that 8-hour period. The actual dose rate will be considerably less than the calculated external dose since most of the energy emitted by the above nuclides is in the form of beta particles that would be absorbed in air and the worker’s clothing. However, because the primary emissions from the nuclides of interest are beta particles, a potential exists for external dose to the skin of a worker. Table 4.2 of the ER lists the dose conversion factors for skin.



### **2.8.2.1 Findings**

The NRC staff compared the effects of the hypothetical spill discussed above to the effects of accidents at ISL facilities (NRC, 1980a). These analyses demonstrate that the consequences for the most credible potential accident should be minor. During inspections, the NRC staff will review the procedures RMD is using to ensure compliance with the commitments made within the licensing documents.

The applicant acceptably described the likely effects of resin spills during facility operations and transportation of material. The applicant provided an acceptable analysis of such accidents and their consequences that is consistent with the URS design, site features, and planned operations. The applicant identified likely impacts from such accidents and included an analysis of the mitigation measures. Adequate response and remediation procedures have either been identified or referenced, and RMD has committed that the CWS facility personnel will be trained to implement such procedures.

Therefore, based on the information provided in the application and the detailed review conducted of the effects of accidents involving the URS, the staff concludes that RMD has adequately analyzed the effects of such accidents. The accidents, when mitigated by the procedures and processes RMD has committed to have in place, will not have a significant impact on public health and safety or the workers.

### **2.8.3 Inhalation and Ingestion Dose**

The dose to a cleanup worker from inhalation of resuspended resin will be negligible since the treatment media particles, at approximately 600  $\mu\text{m}$  in diameter (sieve size 30), are too large to be respirable and are unlikely to remain resuspended for any significant period of time. Any remote possibility of inhaling treatment media particles can be eliminated by wearing a dust mask.

As with spill cleanup in the CWS water treatment facility, ingestion of radioactive materials under a highway spill situation is almost entirely preventable by the use of good work practices. Although highly unlikely, some ingestion may occur by swallowing inhaled particles that reach the esophagus by mucocilliary transport or other mechanisms involving clearance of inhaled large particles.

The applicant provided calculations of the potential dose that a worker may receive from the cleanup of a resin spill. The calculations in section 4.2.3.4.4 of the ER relate to Table 4-3 on page 81 of the ER, containing a list of Uranium in Secular Equilibrium with all of its decay products. Because the accident would cause a loss of secular equilibrium, the short-lived components such as Th-234, Pa-234m, Pa-234 and Th-231 would disburse from the resin, and thus not be considered as available to expose the worker during cleanup. Therefore, the total dose to the worker considers the long-lived isotopes U-238, U-234 & U-235 (which total approximately 11,340 pCi) and that exposure is assumed to be by ingestion only. This is a conservative assumption because the resin size (600  $\mu\text{m}$ ) is well above the <1  $\mu\text{m}$  assumption for respirable particles. Therefore, the resin is unlikely to be inhaled and that makes ingestion the only possible route.

### **2.8.3.1 Findings**

The validity of RMD's calculation that the total potential exposure would be approximately 2.1 mrem (a very small amount) was verified by staff utilizing the Dose Coefficients published in International Commission on Radiation Protection (ICRP) -68 (ICRP, 1995). The staff reasoned that a spill cleanup worker would, in a hypothetical worst case scenario, be exposed to a very low total radiation dose. However, that exposure would be significantly mitigated if the workers(s) utilize basic precautions such as using dust masks, gloves, good work habits and following written procedures.

## **3.0 MANAGEMENT ORGANIZATION AND ADMINISTRATIVE PROCEDURES**

### **3.1 Organization**

Figure 1 of RMD's safety analysis is an organizational chart of the RMD corporate position within, and relationship to, the group of Water Remediation Technology International companies. The position and duties of RMD personnel are described below, in descending order of authority. Qualifications and experience requirements are noted, when applicable. The organizational arrangement allows radiation safety matters to be considered at appropriate management levels.

#### **3.1.1 President of R.M.D. Operations, LLC**

The President of RMD will have the ultimate responsibility for RMD water treatment program operations, including any and all such operations at CWS facilities.

#### **3.1.2 Chief Operating Officer of R.M.D. Operations, LLC**

The Chief Operating Officer (COO) of RMD reports to the President of RMD and has management and financial responsibilities for all aspects of day-to-day operations, including engineering, construction, and installation of the uranium water treatment systems (including the URSs); developing and employing the RMD service network; operations and maintenance of the URSs including exchanging and dispositioning of the spent treatment media; environmental and government affairs; and accounting/finance. The COO will have signatory authority for RMD licenses and permits and the authority to enter into water treatment agreements with CWSs and uranium recovery/disposal agreements for spent treatment media on behalf of RMD.

#### **3.1.3 Corporate Radiation Safety Officer of R.M.D. Operations, LLC**

The Corporate Radiation Safety Officer (CRSO) reports directly to the COO of RMD and is responsible for the development, administration, and enforcement of all environmental programs for the RMD uranium water treatment program and the activities of the SERP, including management of the radiation safety program. The CRSO will also interface with other corporate officers to ensure that all system operations are conducted in a manner consistent with license conditions and applicable regulations and requirements. The CRSO will supervise and monitor the environmental protection and radiation safety programs for all uranium water treatment facilities and will advise the RMD system specialists and the site-specific local utility managers and local utility operators on environmental and radiation safety issues. Responsibilities will include developing and implementing all radiation safety and environmental programs, ensuring that all records will be correctly maintained, and assisting in ensuring compliance with NRC regulations and license conditions. The CRSO will conduct routine training programs for corporate and site employees with regard to the proper application of radiation protection, emergency response, and environmental control programs. The CRSO, when necessary, will inspect uranium water treatment facilities to verify compliance with all applicable radiological health and safety requirements and any quality assurance/quality control

(QA/QC) requirements. In addition, the CRSO will annually review all corporate operating procedures to ensure that site radiation safety procedures will be properly implemented and that radiation exposures will be maintained ALARA.

The CRSO will routinely audit all operational and monitoring procedures and QA/QC and ALARA programs and will be a member of the ALARA audit team and the SERP. The CRSO is authorized to terminate immediately any activity that may be a threat to employees, public health and safety, or the environment, as indicated in reports from any site-specific local utility manager. The CRSO will serve as the primary point-of-contact for purposes of addressing site-specific public health and safety or environmental issues.

RMD will require that the CRSO has, at a minimum, a bachelor of science degree in the biological or physical sciences, engineering, or related discipline from an accredited college or equivalent practical experience/training. The CRSO will attend the following training courses:

- an initial 40-hour RSO training course
- an initial 16-hour naturally occurring radioactive materials (NORM) training course
- a refresher RSO and/or NORM courses or related follow-on training as necessary

### **3.1.3.1 Findings**

To ensure clear lines of communication for radiological safety matters, the NRC will require the following license condition:

- LC Any corporate organizational changes affecting the assignments or reporting responsibilities described in the Environmental Report or in any other R.M.D. Operations, LLC licensing documents shall be reviewed and documented by the R.M.D. Operations, LLC Safety and Environmental Review Panel and made available to the NRC.

To ensure that the RMD CRSO possesses these qualifications and fulfills these training requirements, the NRC will require the following license condition:

- LC The R.M.D. Operations, LLC Corporate Radiation Safety Officer shall possess the professional qualifications and shall satisfy the professional training requirements outlined in the Environmental Report before engaging in any corporate radiation safety officer activities.

### **3.1.4 RMD System Specialists**

In addition to the CRSO, RMD will employ system specialists who will be responsible for monitoring the installation, maintenance and decommissioning of the URS. RMD system specialists will perform the following tasks related to treatment media:

- assure that all URS equipment has been installed and operates pursuant to license requirements at each CWS facility that has entered into a contract with RMD.

- perform maintenance, repair, and/or replacement operations on components of the URS containing licensed material
- monitor performance of local utility operators and URS operating data
- monitor performance and useful life of treatment media
- install fresh treatment media in the URS
- perform media exchanges to remove licensed material attached to spent treatment media
- arrange for the packaging and transportation of spent treatment media
- arrange for the final disposition of licensed material either at an NRC/Agreement State-licensed uranium recovery facility for processing as an alternate feed or at a properly permitted or licensed disposal facility for direct disposal

The RMD system specialists will provide a portion of the “on-the-job” training for local utility managers and operators.

RMD system specialists will be instructed in all the topics covered in the radiation safety training for utility operators. In addition, they will attend an initial NORM training course, 8 to 16 hours in length. The RMD ER includes a typical course outline, providing as an example the outline from a course presented by American Radiation Services, Port Allen, Louisiana. This course will be customized to the URS and associated equipment, as appropriate, to emphasize the areas related to sampling and handling the treatment media, implementing personal protective equipment requirements, minimizing surface contamination, and shipping and manifesting requirements. This training will include an end-of-course test for which a passing score must be attained.

#### **3.1.4.1 Findings**

To ensure that RMD system specialists possess these qualifications and fulfill these training requirements, the NRC will require the following license condition:

- LC R.M.D. Operations, LLC system specialists shall possess the professional qualifications and shall satisfy the professional training requirements outlined in the Environmental Report before engaging in any licensed activities.

#### **3.1.5 Local Utility Managers and Operators (Non-RMD Personnel)**

Site-specific local utility managers will serve as the primary point-of-contact for the CRSO and RMD system specialists when performing licensed activities. Local utility managers will be responsible for supervising local utility operators. Section 3.13.2.3 of the ER describes the training requirements for local utility managers.

Although they will not directly handle the spent treatment media, local utility operators who will monitor the URS on a daily basis may incidentally be exposed to radiation as a result of their

proximity to the system. Local utility operators report directly to the local utility manager, who serves as the primary point-of-contact for the CRSO. Section 3.13.1.3 of the ER describes the tasks to be performed by local utility operators, and Section 3.13.2.3 of the ER describes their training requirements.

### **3.1.5.1 Findings**

To ensure that local utility managers and operators fulfill appropriate basic training requirements, the NRC will require the following license condition:

- LC R.M.D. Operations, LLC will ensure that local utility managers and operators satisfy appropriate basic training requirements outlined in the Environmental Report before initiating licensed activities.

## **3.2 Management Control Program**

### **3.2.1 Performance-Based License**

The following describes the process by which RMD, in conjunction with its SERP, will keep track of and inform the NRC of all CWS facilities it enters into service contracts with, so that the number of such CWS facilities and their locations can be readily determined at any given time. The RMD SERP will evaluate and approve the use of the URS at CWSs to ensure the URS is installed and will operate in a safe and environmentally acceptable manner. The SERP may evaluate and approve or disapprove the installation of URSs, make changes to existing systems, and conduct tests without obtaining prior NRC review and approval. NRC will be notified of newly installed URSs when they become operational and changes made in existing systems. All changes made by RMD personnel at CWSs are subject to NRC inspection and enforcement actions. The inclusion of the following license conditions does not alter or affect the NRC's inspection function or allow RMD to alter license conditions without first obtaining NRC review and approval. Requesting changes to license conditions or performance requirements would require filing a license amendment application pursuant to 10 CFR Part 40.

#### **3.2.1.1 Findings**

To ensure that RMD and its SERP engage in licensed activities within the boundaries specified in the ER and that the company requests NRC approval for license amendments when necessary, the NRC will require the following license condition:

- LC R.M.D. Operations, LLC may, without NRC approval, make changes to standard operating procedures (SOPs) and conduct tests or experiments, provided that they are reviewed by the Safety and Environmental Review Panel and the company ensures the following three conditions are met:
  - (1) The change, test, or experiment does not conflict with any requirement specifically stated in the R.M.D. Operations, LLC license or impair the company's ability to meet all applicable NRC regulations.

- (2) The safety or environmental commitments made in the Environmental Report or other licensing documents are not degraded.
- (3) The change, test, or experiment is consistent with the NRC's findings in its environmental assessment and technical evaluation report.

If any of these conditions are not met, if any alterations are made to the license conditions or to the performance requirements in the license application, or if implementation of uranium water treatment programs is outside the scope of such performance requirements, NRC approval through a license amendment will be required.

Because the SERP and its members are a vital part of the performance-based license concept, the NRC staff will require the following license condition:

- LC The Safety and Environmental Review Panel shall consist of a minimum of three individuals employed or appointed by R.M.D. Operations, LLC, and an R.M.D. Operations, LLC employee shall be designated the Safety and Environmental Review Panel Chairperson. One member of the Safety and Environmental Review Panel shall have expertise in management and be responsible for managerial and financial approval changes; one member shall have expertise in operations and/or construction and shall have responsibility for implementing any operational changes; and one member shall be the Corporate Radiation Safety Officer with the responsibility of ensuring that changes conform to radiological safety and environmental requirements. R.M.D. Operations, LLC may include additional members on the Safety and Environmental Review Panel as necessary to address health physics or other technical disciplines and legal/regulatory issues. Temporary members or permanent members other than the three identified above may be consultants.

To ensure that RMD and its SERP keep the NRC properly informed about the CWSs using RMD's services, the NRC will require the following license condition:

- LC R.M.D. Operations, LLC will be permitted to register and implement new uranium removal systems at Community Water Systems that will operate within the scope of the performance requirements delineated in the Environmental Report. R.M.D. Operations, LLC must register, keep track of, and inform the NRC of all community water system facilities it enters into service contracts with, so that the number of such community water system facilities, uranium removal systems, and their locations can be readily determined at any given time, including those operating under a general license pursuant to 10 CFR 40.22 and those operating under this specific license. Notification to the

NRC shall be made by the last day of the month for any uranium removal system that becomes operational in the preceding month. Notification must contain the name and location of the community water system where the uranium removal system has become operational and contain a facility description summary and relevant features summary similar to Appendix A 3.4 and A 3.5 of NUREG-1757, Vol. 3. The R.M.D. Operations, LLC Safety and Environmental Review Panel will review community water system requirements and document the conclusion that such requirements are within the performance requirements set forth in the Environmental Report. Such documentation shall be subject to NRC inspection. Community water systems and uranium removal systems operating under a general license pursuant to 10 CFR 40.22 will not be required to provide financial assurance as outlined in this license and will not be subject to on-site NRC inspection.

RMD will establish a SERP with at least three individuals representing expertise in management/financial, operations/construction, and radiation safety matters. RMD has committed that the SERP will address specific technical issues with support from other qualified staff members or consultants, as appropriate. Annually, RMD will furnish a written report to the NRC that provides the bases for any changes in the approved programs.

Based on the information provided in the license application and the detailed review conducted of the proposed management control program, the NRC staff concludes that the management control program, modified by the stated license conditions noted above, is acceptable. The use of an SERP to approve changes to the facility commensurate with licensed activities is in accordance with NRC regulations and requirements.

### **3.2.2 Recordkeeping and Reporting**

The RMD recordkeeping program will comply with NRC regulations and requirements. The program must, at a minimum, address two aspects of uranium water treatment facility system operation. The first aspect requires a commitment to keep records of any actions taken or authorized by the SERP until license termination. The records will include written safety and environmental evaluations made by the SERP as part of its analysis for determining whether applicable changes were made in a manner consistent with the license. The second requires a commitment to maintain active records of employee exposure data and to provide employees with access to personal annual dose data in compliance with NRC requirements.

#### **3.2.2.1 Findings**

Although RMD has not specified in its license application the length of time records will be maintained, 10 CFR 40.61(b) details requirements for recordkeeping and retention. Adequate recordkeeping is necessary to allow the NRC to inspect and review the performance of a licensee. In addition to the applicable requirements of 10 CFR 40.61(b), the NRC will require the following license conditions:



- LC The R.M.D. Operations, LLC Safety and Environmental Review Panel shall document and maintain all decisions and determinations and make such documentation available for NRC inspection. R.M.D. Operations, LLC shall provide the NRC with annual reports of all such decisions and determinations. Records shall be maintained in accordance with all applicable NRC regulations.
- LC All written notices and reports to the NRC required under this license shall be addressed in care of the Document Control Desk, Deputy Director, Decommissioning and Uranium Recovery Licensing Directorate (Mailstop T-7 E-18), Division of Waste Management and Environmental Protection, Office of Federal and State Materials and Environmental Management Programs, Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by express delivery to 11545 Rockville Pike, Two White Flint North, Rockville, Maryland 20852-2738. Required telephone notification shall be made to the NRC Operations Center at (301) 816-5100, unless otherwise specified.

### **3.2.3 Standard Operating Procedures**

All RMD employees and local managers and operators will conduct their principal work assignments in accordance with written SOPs. The SERP will review all new or revised SOPs affecting radiation safety before they are implemented. The CRSO will annually audit all operational and monitoring procedures to assure that they are still appropriate and do not conflict with newly established radiation safety policies or regulatory requirements. In addition, the CRSO will annually review all operating procedures to ensure that radiation exposures will be maintained ALARA.

#### **3.2.3.1 Findings**

The NRC views the scope of SOPs to be critical to safe operations. Therefore, the NRC will require the following license condition:

- LC Standard operating procedures shall be developed and followed for all licensed activities, including the handling of licensed materials during normal and accident situations. A copy of the current standard operating procedures shall be kept in the area(s) of the uranium removal system where they are utilized. The Safety and Environmental Review Panel will review and approve all standard operating procedures before they are implemented.

RMD has an acceptable management control program that assures that all safety-related operating activities can be conducted according to written operating procedures. The applicant has provided a process to develop SOPs and has demonstrated that nonroutine work or maintenance activities will comply with radiation safety requirements. The SOPs described above are procedures to maintain radiation doses ALARA, in accordance with applicable requirements.

### **3.3 Audits and Inspections**

#### **3.3.1 Inspections**

The CRSO is primarily responsible for the conduct of inspections and the maintenance of inspection records, as required. The CRSO will conduct site-specific inspections under appropriate circumstances, such as URS malfunction, release of treatment media, and transportation accidents, or upon request of the local utility manager.

#### **3.3.2 ALARA Audit**

Members of the RMD ALARA audit team, which will be a SERP subcommittee, will conduct annual audits of the CWS facilities that have contracted to use RMD's services, the treatment media technology being used to remove uranium, and the radiation protection and ALARA program under the direction of the CRSO. The audit will address the state of technology, containment and radiation safety procedures, and any ALARA-based corrective actions recommended in audit findings. The SERP will review and approve these findings and proposed actions.

#### **3.3.3 QA/QC Audit**

RMD will conduct an annual audit of the radiation monitoring protocol and accident response procedures and all other QA/QC programs in conjunction with the annual ALARA audit by the CRSO. The CRSO may designate individuals to assist in the audit who are qualified in chemistry and monitoring techniques and who do not have direct responsibilities in the areas being audited. The President and COO of RMD will review the audit results, and any corrective actions taken based on these results will be documented and maintained at RMD corporate headquarters.

#### **3.3.4 Findings**

The applicant has established an acceptable QA program. The QA will be applied to all radiological, effluent, and environmental programs in a manner consistent with Regulatory Guides 4.14 (NRC, 1980a) and 4.15 (NRC, 1979). The applicant has agreed to retain survey and instrument calibration records for 3 years and to retain records to demonstrate compliance and evaluate dose, intake, and releases to the environment until the NRC terminates the license.

The NRC staff concludes that the proposed programs are acceptable and ensure compliance with relevant NRC regulations requiring periodic reviews of radiation protection programs.

### **3.4 Radiation Safety Training**

RMD presented a comprehensive radiation safety program in Section 3.13 of its ER. In addition, Section 3.13.2 of the ER presents the specific radiation safety training required for the CRSO, RMD system specialists, and local utility managers and operators.

The radiation safety training program proposed by RMD is consistent with the guidance contained in NRC Regulatory Guides 8.31 (NRC, 2002b), 8.13 (NRC, 1999), and 8.29 (NRC, 1996). The staff finds the proposed content of the training material, testing, on-the-job training, and the extent and frequency of retraining to be acceptable. Furthermore, the staff finds the radiation safety instructions for employees to be acceptable.

### **3.4.1 Findings**

To ensure that all radiation safety requirements are satisfied, the NRC will require the following license condition:

- LC R.M.D. Operations, LLC will implement its radiation safety program as described in Section 3.13 of its Environmental Report. All training sessions and materials shall conform to the requirements of the Environmental Report and the R.M.D. Operations, LLC performance requirements. Any alterations to the radiation safety program outside the scope of the R.M.D. Operations, LLC performance requirements or that fail to meet a condition for action by Safety and Environmental Review Panel shall require NRC approval.

### **3.5 Findings**

The NRC has completed its review of the corporate organization and administrative procedures proposed for use in RMD's uranium removal program. This review included an evaluation using the review procedures in Section 5.1.2 of NUREG-1569 and the acceptance criteria outlined in Section 5.1.3 of NUREG-1569. The applicant has an acceptable corporate organization that defines management responsibilities and authority at each level. The staff finds the applicant's definition of the responsibilities and procedures with respect to development, review, approval, implementation, and adherence to operating procedures, radiation safety programs, environmental and ground-water monitoring programs, QA programs, routine/nonroutine maintenance activities, and changes to any of these to be acceptable. RMD has demonstrated integration among groups that support operation and maintenance of the URS. In the case of a new URS, integration between URS construction and oversight is acceptably detailed. The applicant has established a SERP with at least three individuals representing expertise in management/financial, operations/construction, and radiation safety matters. The applicant demonstrated that the SERP will address specific technical issues, with support from other qualified staff members, or consultants, as appropriate.

Based on the information provided in the application and the detailed review conducted of the corporate organization and administrative procedures for RMD's uranium removal program, the staff concludes that the proposed corporate organization and administrative procedures are acceptable and are in compliance with 10 CFR 20.1101, "Radiation Protection Programs," which defines radiation protection program requirements. In addition, the requirements of 10 CFR 40.32(b), ©, and (d) are also met as they relate to the proposed corporate organization and SERP functions.

## 4.0 RADIATION SAFETY CONTROLS AND MONITORING

### 4.1 Design Features for Radioactive Effluent Control

CWSs using the RMD uranium water treatment system have two potential radioactive effluents—uranium residuals on treatment media from water treatment operations and radiological emissions from such treatment media. Section 2.3.1 of the ER accompanying the RMD license application describes proposed engineering designs of the water treatment system used to contain the treatment media.

#### 4.1.1 Findings

To ensure that such residuals are safely contained, the NRC will require the following license conditions:

- LC R.M.D. Operations, LLC will ensure that all uranium removal system equipment is installed properly before the commencement of licensed activities. After the commencement of licensed activities, R.M.D. Operations, LLC will ensure that no alterations are made to components of the uranium removal system that contain, or potentially contain, licensed material unless approved by either the Safety and Environmental Review Panel or the NRC, as required.
  
- LC R.M.D. Operations, LLC will ensure that all equipment used for media exchanges are functional and operate within the specifications described in the Environmental Report. R.M.D. Operations, LLC system specialists will ensure that all media exchange activities are conducted in accordance with the written procedures and in a manner that minimizes potential releases of spent treatment media.

Based on the information provided in the license application and the detailed review conducted of the radiation design features for control of releases of spent treatment media, modified by the above-stated license conditions, the NRC staff concludes that the radiation design features of the RMD uranium water treatment system are acceptable and in accordance with relevant NRC requirements. In addition, the NRC staff finds that the design features will help to ensure acceptable implementation of the radiation protection program.

RMD has acceptable radiation design features for the control of radioactive releases at CWSs using its uranium water treatment system and has demonstrated that releases of spent treatment media will be controlled and monitored. RMD has committed to use acceptable containment design features to minimize the potential risk of releases.

### 4.2 Radiation Monitoring Programs

RMD has committed to monitoring radiation levels using appropriate SOPs, as well as monitoring radiation exposure rates for all local utility managers and operators or members of the public. Section 3.13.4 of the ER describes the radiation monitoring program.

#### **4.2.1 Findings**

To ensure adequate radiation monitoring at CWSs using the RMD uranium water treatment system, the NRC will require the following license condition:

- LC R.M.D. Operations, LLC shall, at a minimum, use a radiation monitoring program as described in the Environmental Report.

The applicant has proposed an acceptable external radiation exposure monitoring program in the CWS area where the URS is installed. The applicant has provided an acceptable drawing(s) that depicts a generic CWS and URS layout and the location of external radiation monitors. The external radiation monitors are acceptably placed. The applicant has established appropriate criteria to determine which employees should receive external radiation monitoring. The applicant has demonstrated that the range, sensitivity, and calibration of external radiation monitors will protect the health and safety of employees during the full scope of CWS facility operations. Planned radiation surveys are adequate and planned documentation of radiation exposures is acceptable. The staff finds the applicant's monitoring program to be acceptable and that it will protect workers from exposure to beta and gamma radiation.

Based on the information provided in the application and the detailed review conducted of the external radiation exposure monitoring program in the CWS area where the URS is installed, the staff concludes that the external radiation exposure monitoring program is acceptable and is in compliance with 10 CFR 20.1101, which defines a radiation protection program and ALARA requirements; 10 CFR 20.1201(a), which defines occupational dose limits; 10 CFR 20.1501, "General," which provides requirements for surveying and radiation monitoring; 10 CFR 20.1502, which defines conditions requiring individual monitoring of external dose; Subpart L, "Records," of 10 CFR Part 20, which specifies recordkeeping requirements; and Subpart M, "Reports," of 10 CFR Part 20, which defines reporting requirements.

#### **4.3 Environmental Monitoring and Response Program**

RMD has committed to monitoring all potential releases of licensed material and to responding to such releases in a manner that is adequately protective of public health and safety and the environment. In an effort to control releases, RMD has presented detailed information regarding emergency response procedures for releases of spent treatment media during water treatment operations, media exchanges, and transportation of such treatment media in Sections 3.13 and 3.14 of the ER. RMD has also presented a description of its recommended containment measures for potential releases of treatment media in Section 2.3.2 of the ER.

##### **4.3.1 Findings**

To ensure adequate environmental monitoring and response at CWSs using the RMD uranium water treatment system, the NRC will require the following license conditions:

- LC R.M.D. Operations, LLC shall, at a minimum, use an environmental monitoring program and emergency response procedures as described in the Environmental Report.

- LC Where the uranium removal system is located, R.M.D. Operations, LLC shall ensure the fire marshal or equivalent has been contacted and provided instruction on uranium source material hazards and possible effects from a fire.

#### **4.4 Contamination Control**

RMD has committed to requiring that all RMD system specialists and local utility managers and operators adhere to SOPs and/or emergency procedures regarding contamination control, including surface contamination of the URS and contamination of personnel (e.g., clothing, shoes). Sections 3.13.5, 3.13.6, and 3.14 of the ER describe these SOPs and requirements.

##### **4.4.1 Findings**

To ensure adequate contamination control at CWSs using the RMD uranium water treatment program, the NRC will require the following license condition:

- LC R.M.D. Operations, LLC shall, at a minimum, use a contamination control program as described in the Environmental Report.

The NRC has completed its review of the contamination control program in the CWS area where the URS is installed. This review included an evaluation using, in part, the review procedures outlined in Section 5.7.6.2 of NUREG-1569 and the acceptance criteria outlined in Section 5.7.6.3 of NUREG-1569.

The applicant has committed to establish an acceptable contamination control program in the CWS area where the URS is installed.

## 5.0 SECURITY PROCEDURES AND MEASURES

The security procedures and measures for CWSs using the RMD uranium water treatment system are acceptable, including both active and passive restraints in the CWS area where the URS is installed. RMD has identified acceptable reasonable passive controls, including the sealed treatment vessel. RMD also understands that the NRC may, at its discretion, issue compensatory measures or other security requirements for the company's uranium water treatment systems.

### 5.1 Findings

To ensure adequate security at CWSs using the RMD uranium water treatment system, the NRC will require the following license conditions:

- LC R.M.D. Operations, LLC shall, at a minimum, use security procedures and measures as described in the Environmental Report. R.M.D. Operations, LLC shall also comply with and implement, in conjunction with appropriate site personnel and community water system security requirements, NRC compensatory measures or other security requirements issued by the Commission.
  
- LC To prevent the public from accessing the uranium removal system when unattended, the system shall be housed in a locked shed or locked structure, be within the locked community water system facility, and/or be within a locked fenced-in area and properly marked at all times, in accordance with the requirements of 10 CFR Part 20.

Because of its importance as a community water supply, the CWS site is typically secured, regardless of the need to remove radionuclides from the water. At a minimum, well houses at these sites will be locked. Many sites, although not all, will also be secured with locked fences. If the URS is located in the open, outside of a building (which is an atypical situation), the NRC will require that such treatment sites will be fenced and locked. In addition to site security, the licensed material will always be contained in a sealed treatment vessel.

Based on the information provided in the license application and the detailed review conducted of the security procedures and measures for water treatment facilities using the RMD uranium water treatment system, as modified by the above license conditions, the NRC staff concludes that the security procedures and measures will ensure compliance with applicable NRC requirements and are acceptable.

## **6.0 EMERGENCY PROCEDURES AND PREVENTIVE MEASURES**

### **6.1 Media Exchanges**

RMD has committed to implementing SOPs for media exchanges to ensure that all spent treatment media is transferred from the URS to DOT-approved containers. Furthermore, RMD is committed to ensuring that these containers are transported in DOT-approved vehicles to properly licensed facilities for final disposition in a manner that minimizes the potential release of spent treatment media and that adequately protects public health and safety. Sections 3.14.3 and 3.14.4 of the ER describe the SOPs and other requirements for media exchanges.

#### **6.1.1 Findings**

To ensure adequate protection of workers during media exchanges at CWSs using the RMD uranium water treatment system, the NRC will require the following license condition:

- LC R.M.D. Operations, LLC shall, at a minimum, use standard operating procedures for media exchange and other related procedures as described in the Environmental Report.

### **6.2 Transportation Accident Response**

RMD has analyzed highly unlikely but credible potential accident scenarios and doses to members of the public resulting from accidental releases of spent treatment media during transportation. RMD has committed to using appropriately licensed or permitted transportation contractors to transfer spent treatment media from CWSs to properly licensed facilities for final disposition. Transport containers will be approved, under appropriate DOT regulations, for shipment of Class 7 radioactive material.

In the event of a transportation accident, the primary level of response will be the transportation contractor's established response team and procedures. RMD will coordinate transportation accident response procedures with the transportation contractor, including post-remediation accident site surveys, and will conduct additional accident site surveys as necessary.

#### **6.2.1 Findings**

To ensure adequate transportation accident response at CWSs using the RMD uranium water treatment system, the NRC will require the following license condition:

- LC R.M.D. Operations, LLC shall, at a minimum, use transportation accident response standard operating procedures in accordance with the DOT-approved transportation contractor's response procedures. R.M.D. Operations, LLC will also conduct followup accident site surveys, as necessary.



RMD has adequately described the anticipated effects from an unlikely but credible accident that could result from the transfer of spent treatment media to properly licensed or permitted facility for final disposition. The planned response programs are acceptable and include appropriate mitigation and remediation measures. The applicant recognizes that its response program must comply with the notification requirements in 10 CFR 40.60, "Reporting Requirements."

## 7.0 WASTE MANAGEMENT

Section 3.14 of the ER discusses waste management alternatives. The RMD waste management philosophy is that uranium, once removed from a given drinking water source, should not be reintroduced into the local environment. RMD has committed to ensure that all uranium-laden (spent or fully-loaded) treatment media from CWSs using the company's uranium water treatment program is transferred to properly licensed or permitted facilities for final disposition. RMD prefers that the spent treatment media be disposed of in an NRC- or Agreement State-licensed uranium recovery facility for processing as an alternate feed. In the event that no such facility is available, RMD will transfer the spent treatment media to a properly licensed or permitted facility for direct disposal. RMD will obtain properly executed contracts with uranium recovery or disposal facilities before initiating licensed activities and will designate a final disposition location for spent treatment media at each CWS uranium water treatment facility.

### 7.1 Findings

To ensure adequate waste management at CWSs using the RMD uranium water treatment program, the NRC will require the following license conditions:

- LC R.M.D. Operations, LLC shall transfer uranium-laden (spent or fully-loaded) treatment media only to properly licensed or permitted facilities for final disposition. R.M.D. Operations, LLC will obtain properly executed contracts with these facilities before initiating licensed activities and will designate a set of final disposition locations for spent treatment media at each community water system uranium water treatment program. R.M.D. Operations, LLC will select a final disposition location from the designated set of locations before transferring each set of spent treatment media.
  
- LC Uranium-laden (spent or fully-loaded) treatment media is not to be stored at the community water system for greater than 60 days and shall only be contained within the ion exchange vessel or DOT-approved containers.

RMD has acceptably described the potential final disposition alternatives for spent treatment media from its uranium water treatment system. The potential final disposition alternatives proposed by RMD are acceptable and will result in adequate protection of public health and safety. Based on the information provided in the license application, the staff finds the RMD waste management program to be acceptable.

## 8.0 DECOMMISSIONING ACTIVITIES

RMD has committed to decommissioning URSs when necessary. Section 3.14.5 of the ER discusses decommissioning tasks and other requirements for a URS. RMD has also committed to a financial assurance methodology to estimate decommissioning costs for its URSs. This methodology will allow RMD to estimate decommissioning costs for each of its URSs on a site-specific basis and to document such estimates in its financial assurance mechanism. Section 3.14.5 of the ER presents this methodology. Decommissioning cost estimates for the URS and other relevant aspects of the uranium water treatment program depend on the size of the system and the final disposition pathway for spent treatment media. Spent treatment media destined for processing at a licensed uranium recovery facility as an alternate feed (RMDs preferred disposition pathway) will result in one range of decommissioning cost (Table 3-2 of the ER). Spent treatment media destined for direct disposal at an appropriately licensed or permitted facility will result in a second range of decommissioning costs (Table 3-3 of the ER). RMD has estimated the potential range of decommissioning costs for both disposition pathways.

RMD is committed to decommissioning URSs and associated areas within the water treatment facility housing the URS based on the unrestricted use criteria. Given the self-contained nature of the URS and the limited amount of licensed material contained therein before media exchanges, RMD has determined, and the NRC staff agrees, that decommissioning should be relatively straightforward. The NRC staff will monitor decommissioning activities as they occur and will adjust license conditions as necessary to protect public health and safety and the environment.

### 8.1 Findings

NRC staff has evaluated the range of decommissioning cost estimates presented in the ER and finds them to be reasonable and acceptable. To ensure the decommissioning of individual URSs at CWSs using the RMD uranium water treatment system, the NRC will require the following license condition:

- LC R.M.D. Operations, LLC shall conform its decommissioning activities to the methodology and requirements described in the Environmental Report.

## 9.0 FINANCIAL ASSURANCE

RMD has committed to providing adequate financial assurance for decommissioning activities at CWSs using the URS. The financial assurance alternatives described in detail in the RMD license application letter did not meet the NRC's financial assurance criteria. RMD proposed that, pursuant to 10 CFR 40.36 (e) (4) or a specific exemption from municipality licensee requirements, the company will obtain properly executed statements of intent or guarantees from municipalities for the estimated decommissioning costs before initiating licensed activities. RMD also indicated that it will obtain other acceptable financial assurance mechanisms from private entities operating CWSs before initiating licensed activities.

After discussing the issue with the NRC staff, RMD has agreed to modify its method for providing financial assurance. RMD will create a standby trust for decommissioning costs, with the NRC as beneficiary. In addition, within each contract with a CWS, RMD will make the NRC an intended third party beneficiary with the right to enforce the provisions of the contract as it applies to decommissioning or other related activities.

This method of financial assurance is not explicitly provided for in 10 CFR 40.36, "Financial Assurance and Recordkeeping for Decommissioning." Allowing RMD to use this method will require issuing it an exemption from the 10 CFR 40.36 requirements. To grant an exemption, the following three requirements must be met, as specified in 10 CFR 40.14, "Specific Exemptions":

- (1) The exemption must be authorized by law.
- (2) The exemption must not endanger the public health and safety or the common defense and security.
- (3) The exemption must be in the public interest.

In evaluating whether to issue RMD an exemption from 10 CFR 40.36, the NRC staff reviewed a sample financial assurance agreement and contractual documents that could be used with CWSs. The NRC staff finds that the exemption to the regulations is authorized by law. The method of providing a third-party guarantee for financial assurance does not endanger the public health and safety or the common defense and security since the proposed financial mechanism will provide adequate assurance, when compared to the existing 10 CFR 40.36 regulatory mechanisms, that funds will be available when needed for decommissioning. The proposed financial assurance mechanism serves the public interest by reducing the financial burden to a large number of CWSs that may be affected over time, while reducing the levels of uranium in the environment and the public's exposure to uranium in drinking water.

RMD is a subsidiary of a larger corporate structure. RMD's parent company, WRT International, LLC, has the authority to require that the CWS's make payments directly to WRT International, LLC. Payments made to WRT International, LLC are outside the control of RMD. However, to assure that RMD will have funds available for decommissioning, RMD must have control over the payments. The staff's evaluation of RMD's financial ability to fund decommissioning was based on RMD receiving income directly. Therefore, RMD's contracts with CWS's must specify that payments for services rendered and payments required for contract termination be made directly to RMD.

## 9.1 Findings

The NRC staff finds that, for the reasons stated above, a specific exemption to the regulations is warranted. To ensure completion of radiological decommissioning activities at CWSs using RMD's uranium water treatment system, the NRC will require the following license conditions:

- LC Before a uranium removal system becomes operational, R.M.D. Operations, LLC shall create a standby trust, acceptable to the NRC, for the uranium removal system located at a site-specific community water system. R.M.D. Operations, LLC shall obtain appropriate financial assurance mechanisms for site-specific public or private community water systems before the uranium removal system becomes operational. For public community water systems, R.M.D. Operations, LLC may obtain statements of intent or guarantees pursuant to 10 CFR 40.36 (e) (4) in accordance with R.M.D. Operations, LLC license application dated September 27, 2005, and subsequent supporting documentation dated August 14, 2006, August 30, 2006, and September 13, 2006. For private community water systems, R.M.D. Operations, LLC will obtain acceptable financial assurance mechanisms pursuant to 10 CFR 40.36 in accordance with R.M.D. Operations, LLC license application dated September 27, 2005.
- LC The contract between R.M.D. Operations, LLC and each community water system shall include the statement, "For purposes of this Agreement, the U.S. Nuclear Regulatory Commission (NRC) shall be considered an intended third-party beneficiary of any Financial Assurance mechanism required for activities under this Agreement and shall be granted rights to enforce the provisions of such financial assurance mechanism for Decommissioning or other related activities." Additionally, in the contract between R.M.D. Operations, LLC and each community water system, the R.M.D. Operations, LLC must require that payments for its services and any contract termination payments be made directly to R.M.D. Operations, LLC.
- LC R.M.D. Operations, LLC will prepare site-specific decommissioning cost estimates pursuant to the methodology delineated in the Environmental Report before initiating licensed activities. R.M.D. Operations, LLC will document such decommissioning cost estimates in its financial assurance mechanism for each community water system. R.M.D. Operations, LLC will adjust decommissioning cost estimates pursuant to applicable NRC requirements, such as changes in engineering or design, and economic conditions, such as inflation, on an annual basis.

## 10.0 CONCLUSION

The NRC staff has completed the technical and safety review of the RMD license application for a source material license. The NRC staff concludes that RMD has satisfied the requirements of 10 CFR Part 40 and other applicable requirements. The staff further concludes that issuance of the license to RMD, including the license conditions set forth in this TER will not be inimical to the common defense or security or to public health and safety. The NRC staff also finds that RMD has provided adequate assurances that applicable NRC requirements will be satisfied. This TER supports the NRC staff's finding that issuing the requested license to RMD will be in accordance with 10 CFR part 40 requirements and with all applicable safety requirements of the AEA.

The Commission set forth a policy in the staff requirements memorandum to SECY 96-252 (NRC, 1997) that 10 CFR part 40 materials licenses could be issued for a term of up to 10 years. The Commission also stated that the use of license terms shorter than 10 years is appropriate on a case-specific basis and for situations where the industry or NRC has not had extensive experience in using or regulating the proposed use of the material. The RMD URS uses the same technology as used in *in situ* leach uranium extraction facilities. The industry and NRC have over 30 years experience in using and regulating the use of ion exchange technology and source material created by the use of ion exchange technology as proposed by RMD. Therefore, RMD meets the criteria of a license term of 10 years and NRC staff recommends a license term of 10 years.

## **11.0 LIST OF PREPARERS**

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