REGULATORY ENGAGEMENT PLAN

FOR

SUBMITTAL AND APPROVAL OF AN APPLICATION

TO

CONSTRUCT A NEW RESEARCH AND TEST REACTOR

submitted by

THE UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

in collaboration with

ULTRA SAFE NUCLEAR CORPORATION

to

U.S. NUCLEAR REGULATORY COMMISSION

Office of Nuclear Reactor Regulation

Division of Advanced Reactors and Non-Power Production and Utilization Facilities

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1 INTRODUCTION

The University of Illinois at Urbana-Champaign (University of Illinois, university or UIUC) informed the U.S. Nuclear Regulatory Commission (USNRC), Office of Nuclear Reactor Regulation, of the university's intent to deploy a Research and Test Reactor (RTR) on the UIUC campus. UIUC's intent, expressed in the Letter of Intent (LOI) is to submit an application for a Construction Permit (CP) for a test reactor facility on the UIUC campus [1]. UIUC will be the owner-operator of the proposed RTR, to be licensed and operated at a power level of 15 MWt. UIUC plans to submit the CP application as permitted under 10CFR50.23, described in 10CFR50.21(c), and in accordance with the Atomic Energy Act (AEA) Sections 31 and 104(c).

The RTR planned for deployment at the university is the Micro-Modular Reactor (MMR™)[1], a High Temperature Gas Cooled Reactor (HTGR) design developed by Ultra Safe Nuclear Corporation (USNC), Seattle, WA[2]. UIUC's MMR™ based RTR meets all the applicable requirements of the AEA Section 104 and 10CFR50 for a test reactor that is designed, constructed, operated, and utilized for prototype testing, research, and training, which will be documented in UIUC's application for a CP and, subsequently, for an Operating License (OL).

The UIUC team is pleased to submit this Regulatory Engagement Plan (Plan) including a project description, our proposed regulatory strategy, a schedule for implementing our plan and other related tasks to maintain an effective engagement with USNRC staff throughout the licensing process. In the preparation of this plan, we have taken into account USNRC's Pre-application Engagement guidance [2].

As described herein, we intend to engage with USNRC staff in pre-application discussions through various meetings, submission of White Papers, Topical Reports and engage in dialog on USNRC's positions and inputs on the technology, the facility, utilization and regulatory challenges for deploying a MMR™ based RTR on the UIUC campus prior to the full submittal of the application. We intend to use established USNRC guidance in NUREG-1537, as amended through USNRC's Interim Staff Guidance (ISG) [3],[4], and other guidance (e.g. Reg Guide 1.232) as applicable, in the preparation of the Preliminary Safety Analysis Report.

2 PRIMARY CONTRIBUTING INSTITUTIONS AND POINTS OF CONTACT

2.1 University of Illinois at Urbana-Champaign

UIUC is a non-profit educational institution, as defined in 10 CFR 170.3 and 171.5. UIUC is a public land grant research university in Illinois, founded in 1867 and located in the twin cities of Champaign and Urbana. The Department of Nuclear, Plasma and Radiological Engineering (NPRE) operates as one of twelve departments in UIUC's Grainger College of Engineering. UIUC is the flagship institution of the University of Illinois system.

UIUC will be the owner and operator of the RTR and related facilities, and as such will be the USNRC licensee of record. UIUC, supported by USNC, will be responsible for the preparation and submittal of the construction permit application and all pre-application and post-application activities, as well as manage the eventual construction and commissioning of the MMR™ reactor and related support facilities.

[1] MMR is a registered trademark of Ultra Safe Nuclear Corporation
[2] www.usnc.com

The Department of Nuclear, Plasma, and Radiological Engineering (NPRE) was the home of one of the early non-power reactors, a TRIGA® Mark II reactor which has been successfully decommissioned and the site released for unrestricted use. UIUC successfully and safely operated the TRIGA® in the heart of campus for 38 years (1960-1998), and its fuel was safely stored on-site until 2004. The UIUC TRIGA® accounted for many “firsts” in the annals of nuclear engineering through its operating history. The reactor site’s restoration tp greenfield status demonstrates UIUC’s abilities at every stage of reactor licensing, construction and operations, and final decommissioning. The Department also operates the Hybrid Illinois Device for Research Applications (HIDRA), a small scale tokamak fusion reactor. The university also has extensive experience in managing, developing, and carrying out large technology and construction projects. University capital projects can total over $500M at any given time.

Key points of contact for the regulatory engagement with USNRC are:

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2.2 Ultra Safe Nuclear Corporation

USNC was founded in 2011 and is a 100% U.S.-owned entity, incorporated in the State of Delaware and with headquarters in Seattle, WA. The enterprise is a leading technology developer with a vertically integrated supply chain including design and development of advanced nuclear reactors, nuclear fuel manufacturing, operating the plants and selling energy or power, as well as other advanced nuclear technologies for terrestrial and outer space applications.

USNC’s flagship product is the very small HTGR, the Micro Modular Reactor (MMR™), based on TRISO microsphere fuel form compacted in Fully Ceramic Micro Encapsulated (FCM®)[3] compacts. USNC’s other products, using its FCM® fuel technology, include reactors for Nuclear Thermal Propulsion, Lunar Fission Surface Power, and Chargeable Atomic Batteries.

Key points of contact for the regulatory engagement with USNRC are:

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[3] FCM is a registered trademarks of Ultra Safe Nuclear Corporation

The licensee (UIUC) and reactor designer (USNC) teams will be supported by specialist teams from industry and U.S. national laboratories in the preparation of the license applications. The overall project structure is further defined in Section 5.1 of this document.

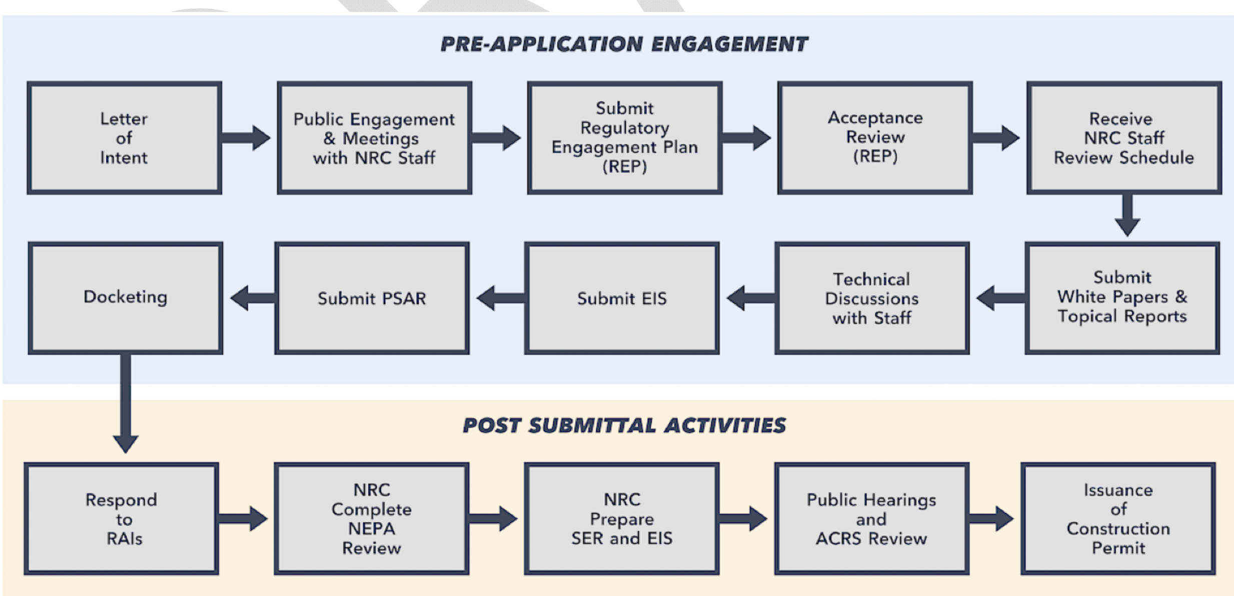
3 OVERALL STRATEGIC APPROACH – REGULATORY PATHWAY

Exhibit 3-1 shows a high-level flow chart that UIUC (applicant) and USNC (reactor designer) propose for engaging with USNRC in the conduct of a full range of activities from submittal of this document, to submitting a PSAR, as well as pre- and post-submittal engagements, to achieve the desired result of receiving a USNRC permit to prepare the proposed site and construct the RTR.

The university's efforts to deploy a Gen IV microreactor based RTR at UIUC, with the goal, in part, to replace and enhance the capabilities lost due to the decommissioning of the TRIGA® Mark II RTR, have been ongoing since August 2019 (see Section 6). Regulatory engagement prior to the submittal of the LOI has been primarily to determine the suitability of the RTR pathway in licensing a microreactor, given the broad nature of research the campus is planning.

The university is not planning any commercial activity but is interested in demonstration of power production and integration into the existing university owned and operated electricity and steam production system as allowed under an RTR license consistent with the definition under the Atomic Energy Act. Therefore, at no time would the power production be used as a commercial product and sold by the university. Preliminary site evaluations have already been performed for the RTR deployment and primary and alternative siting locations for a Gen IV micro-reactor have been identified. These evaluation criteria include geotechnical considerations, location relative to protected lands, location relative to other hazardous facilities, local population density, and location relative to essential services. Towards the goal of licensing a Gen-IV micro-reactor on the campus site, the Letter of Intent (LOI) was submitted by UIUC [1]. to the USNRC Office of Nuclear Reactor Regulation, expressing the university's intent to deploy an RTR using USNC's MMR™ HTGR technology.

Exhibit 3-1: Proposed Licensing Process



3.1 Pre-Application Activities

Taking guidance from NUREG-1537, as amended [3],[4], the license application activities will be structured to allow for pre-application safety analyses, independent assessments of the reactor, development and submittal for review of Topical Reports, White Papers and Site-Specific Studies, including Environmental Studies. Furthermore, all activities associated with the application will be compliant with the applicable requirements of 10 CFR 50 Appendix B and NQA-1 quality standards. A graded approach commensurate with the proposed Gen-IV technology and MMR specific design will be followed in the application of these requirements.

3.2 Post-Submittal Activities

Post submittal activities include providing timely support, as requested, to USNRC staff in the review of the application. These include:

- Responding to Requests for Additional Information (RAIs) in a timely manner,
- Support for additional USNRC meetings that may be required in support of the application
- Providing necessary additional information, upon request, in the preparation of supporting USNRC documents, leading up to the issuance of the Construction Permit.

The project team will strive to submit responses to RAIs and other necessary information within agreed upon timeframes to ensure that the schedule is not adversely affected.

4 USNRC-APPLICANT TEAM COMMUNICATIONS PROTOCOLS

Effective and clear communication between UIUC, USNC, USNRC, and other project partners during various phases of the application (pre-submittal/submission/post-submittal) will play an important role in smooth and timely resolution of safety significant issues and timely completion of the license-to-construct process. The applicant team (described in section 5.1) anticipates active communication with the USNRC throughout the licensing process. The frequency and mode of communication will vary based on the needs and availability of the USNRC and applicant team. The applicant team can accommodate teleconference, video conference, and in-person meetings at the preference of the USNRC.

4.1 Oral Communications

Non-public drop-in meetings will be sought for non-technical discussion where either the applicant team or the USNRC would benefit from clarification of general information such as schedule and status updates and planning for future communication. Public meetings will provide the opportunity to discuss the project details and, whenever possible, the technical aspects of the technology and planned deployment. Drop-in meetings will be supported by presentations from the applicant team.

4.2 Written Communications

Written communications during preapplication is expected in the form of email, presentations (from drop-in or public meetings) and topical reports in order to support the CP application submission. Email is the preferred method for all general correspondence. White papers will be used to describe the applicant team's position on a specific issue in order to facilitate alignment with USNRC staff. White papers will largely focus on high level topics central to the technology and deployment approach, and can clarify the need for more detailed technical or topical reports. Additional white papers and/or technical reports will be provided as needed based on the ongoing pre-application engagement with staff.

4.3 Public Participation

The protocol for participation of the public (except for commercially sensitive or security-related matters) during the licensing process including the meetings, access to documents, USNRC-sponsored information sessions and scoping meetings, review of USNRC safety evaluations, environmental review, and hearings, will be defined based on the USNRC guidance. To the maximum extent practical, the applicant team will make every effort to make materials and discussions available for public access.

5 PROJECT STRUCTURE

UIUC is developing and deploying the MMR™ as a campus resource to take advantage of the diversity of expertise and spirit of innovation across all relevant areas of science and technology at the University of Illinois. The university also plans to partially re-power its fossil fuel fired Abbott power station with the MMR™ Energy System to provide a zero-carbon demonstration of district heat and power to campus buildings as part of its green campus initiative. The project team aims to demonstrate how micro-reactor systems integrate with existing fossil fuel infrastructure to accelerate the decarbonization of existing power-generation facilities.

In addition to supporting the university's clean energy goals, the proposed RTR will serve as an innovative and valuable workforce training tool for a new generation of nuclear scientists, engineers, and operators. UIUC's decommissioned TRIGA® reactor that served this purpose operated for 38 years with a site license in the heart of campus. UIUC now propose the deployment of a next generation energy research facility for training the emerging clean-energy focused workforce.

The licensing effort will be carried out and supported through collaborative efforts with major U.S. Industry partners and National Laboratories in nearly all aspects of the analysis, design, licensing, construction, and operations. USNC will be a full collaborative partner in all phases of the project as the MMR™ designer, technology provider and vendor of record. MPR Associates and AECOM will support USNC as industrial partners for nuclear island analytical support and site specific analyses respectively. Additional support for the CP application is expected to be provided by National Laboratories as well as the DOE. Other partners may be added for specific tasks and expertise, as needed during execution. The role of each identified partner is further discussed in the section that follows.

5.1 Industrial Partners

Further to UIUC's involvement, the license application will be supported by several industrial partners including the reactor vendor. Industry partners with their activities under the application are presented below.

Ultra Safe Nuclear Corporation, Seattle, WA

- Reactor vendor and lead organization for reactor and facility design under NQA-1 compliant QA program
- Implement application QA program for NQA-1 compliance
- Update reactor Design as needed to meet Part 50 licensing requirements
- Manage the performance of Safety Analyses with NRC endorsed codes
- Lead the preparation of Topical Reports and other technical reports as needed
- Lead the development of NUREG-1537 compliant PSAR and construction permit license application
- Support the Post License Submittal RAI efforts

MPR Associates. Alexandria, VA

- Perform Quality Assurance Gap Analysis of the USNC Quality Management System and Audits as needed
- Support USNC in the performance of Safety Analyses
- Support PSAR development
- Support UIUC as required with the License Application process
- Support the Post License Submittal RAI efforts

AECOM, Greenville, SC

- Evaluation of existing UIUC Site Data
- Conduct baseline field studies
- Preparation of baseline reports (noise, traffic, etc.)
- Cultural Resource Study/ Historic Architecture Study
- Develop Environmental Reports to support NEPA compliant review for issuance of CP
- Assist with the preparation of relevant portions of the PSAR

National Laboratory Partners Idaho National Laboratory and Argonne National Laboratory:

- Perform independent verification of USNC's Steady State and Transient Analyses

U. S. Department of Energy, Office of Nuclear Energy

UIUC aims to partner with USDOE under the Research Reactor Infrastructure (RRI) Program to:

- Develop the fuel supply plan for the deployment of the RTR

6 PROJECT BACKGROUND

UIUC has spent the past two and a half years working to position the campus to be an early site for micro-reactor technology deployed as an advanced research and test reactor. This effort has included engagement with campus students, staff, and administration; local community; regulatory bodies; the nuclear industry and broader nuclear community; and local, state, and federal governments. Public engagement and community awareness has been prioritized from the project's inception and will continue to be a priority. These engagements have helped to shape many aspects of the applicant team's approach, including the vendor partner, potential reactor sites, and planned reactor use.

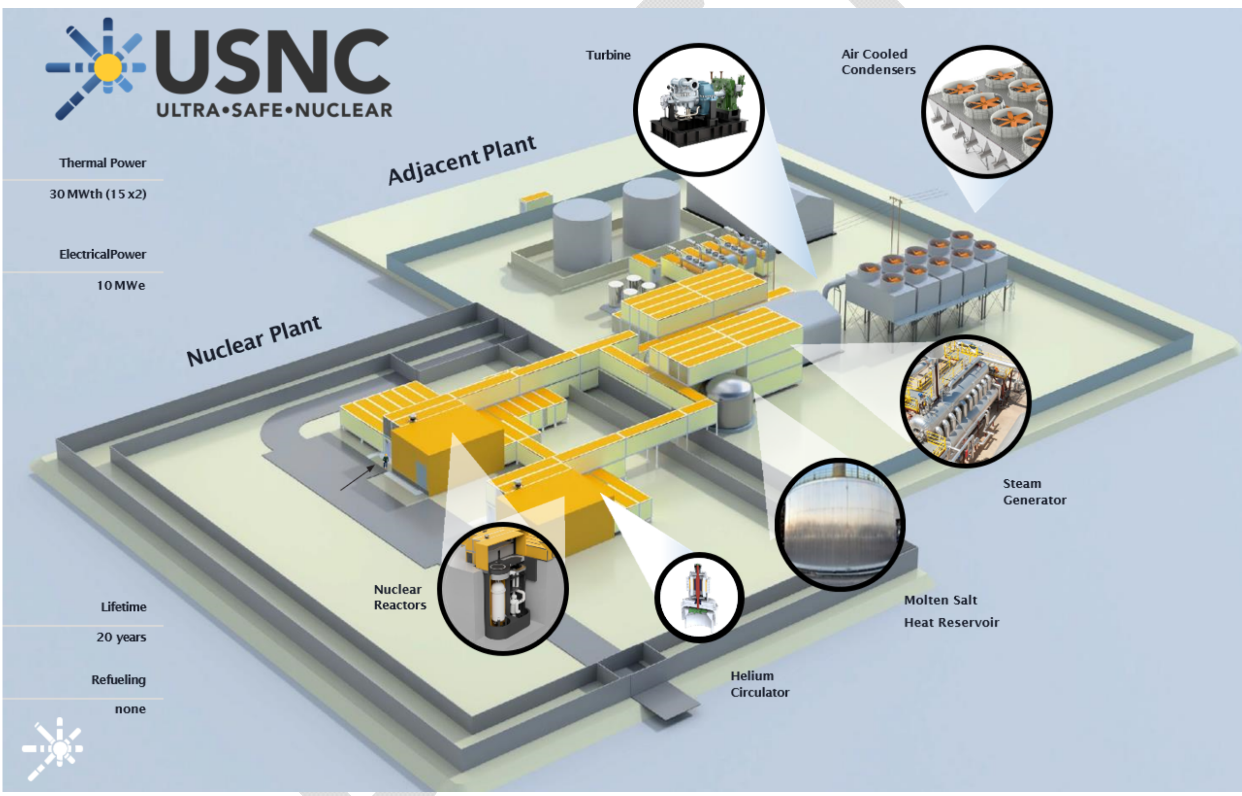
6.1 Technology

Design of the proposed UIUC RTR derives from HTGR technology that has been deployed worldwide (Germany, United States, Japan, and China) since the late 1960s. HTGR designs have also been developed as advanced modular and direct power conversion designs for electricity and process heat applications, some of which have been previously reviewed by and documented with USNRC as part of prior pre-application licensing engagements. These include the Modular HTGR (MHTGR) [5], the Next General Nuclear Plant (NGNP) [6] and the Gas-Turbine Modular Helium Reactor (GT-MHR). In addition, a HTGR based RTR, the High Temperature Teaching and Training Reactor (HT3R) was proposed and designed for the University of Texas at Permian Basin [7], but the project was cancelled before entering USNRC licensing phases.

6.1.1 The MMR™ Reactor and Energy System

The UIUC RTR will use USNC's MMR™ high temperature and inert gas cooled reactor based energy system that combines a nuclear reactor and associated heat rejection system ('Nuclear Plant') and an 'Adjacent Plant' that are physically and functionally separated. This split allows for a fully standardized RTR to be constructed and commissioned, that can be combined with a non-nuclear power conversion system that can be tailored to suit a variety of applications including supplying electricity, high-grade process heat, low-grade district heating/cooling, or any combination thereof (cogeneration). This design feature can simplify the regulatory review process across a fleet, without sacrificing adaptability. The use of molten salt as a thermal energy storage medium makes this split feasible, as it effectively decouples the reactor from the energy utilization side of the system. Exhibit 6-1 illustrates this separation.

Exhibit 6-1: MMR™ Facility Layout displaying the Nuclear Plant (two micro-reactors) and an Adjacent Plant with molten salt heat storage



Key features of the MMR™ technology include:

<u>Simplicity</u>: The MMR™ design ensures simplicity and plant safety is completely assured by intrinsic and inherent means. Simple for public acceptance, simple to license, simple to build and simple to operate.

<u>MMR™ Technology</u>: The technology will incorporate the USNC proprietary FCM™ fuel that brings reduced risks compared to standard TRISO in graphite compacts. An MMR™ based on FCM™ will not just meet regulatory limits but effectively eliminate nuclear risk from the reactor, by assuring that design and beyond design basis accidents, however extremely unlikely, have negligible consequences, which will foster unparalleled public acceptance

MMR™ Approach: The MMR™ is designed to incorporate proven and mature technology to the greatest extent practical. Components are selected based on available commercial suppliers. The primary loop components have been used in previous HTGR designs (graphite blocks, vessels, control rods) or oil and gas plants (printed circuit heat exchanger, circulator with electromagnetic bearings). The molten salt intermediate circuit is based on the same conditions and components used in concentrated solar power plants. The steam circuit is based on conventional superheated steam turbine technology. The safety characteristics of small HTGRs have also been demonstrated by previous operating HTGRs.

In summary, the MMR™ facility is an inherently safe, and proliferation-resistant design that addresses all the key parameters to development and deployment of advanced reactors.

6.1.2 The MMR™ Reactor Design Characteristics

The 15 MWt MMR™ reactor design and technology for deployment as an RTR at UIUC has a high Technology Readiness Level. Key safety related design features of the reactor are:

- Inherent (core-wise) and intrinsic (plant-wise) safety obtained by: 1) high retention of fission products in the TRISO fuel particles, and then in the FCM™ ceramic matrix; 2) controlling the reactor reactivity via a large negative temperature coefficient; and 3) the large heat capacity of the all-graphite core and removal of residual heat from the core via a passive heat transfer path.
- Assurance of negligible radioactive fission product release that requires no electrical power, no active systems, and no operator action.
- By using HALEU, thereby achieving higher burnup and long core lifetimes, end-of-life used fuel volumes are reduced. The MMR™ design achieves an average burnup of almost [100 GWd/t]. Even with this burnup, the MMR™ reactor essentially operates as a nuclear battery without refueling for the life of the core. As a result, it offers proliferation resistance, no fresh fuel or spent fuel needs to be stored on site during the operating life and there will be no access to the core.

Exhibit 6-2: Major Characteristics of MMR™ Based RTR Design

Micro Reactor Parameter	MMR™
Reactor core	Prismatic shaped, stacked graphite fuel blocks that hold the fuel and allow passage of reactor coolant through the core
Reactor fuel	TRISO coated, 19.75 w/o (percent by weight) U-235 UCO fuel kernel encapsulated in FCM fuel compacts
Reactor coolant	Helium
Reactor thermal power	15 MWt
Heat transfer mechanism	Heat is transferred from the fuel compacts to the helium. The helium is circulated through the core, transfering the heat through a heat exchanger to the molten salt energy storage system for other non-nuclear uses.

Micro Reactor Parameter	MMR™
Amount of waste heat disposal	The reactor has [<500 kWt] of heat dissipated to the environment
Method of waste heat disposal	The reactor has a Reactor Cavity Cooling System that removes heat from the reactor cavity.
Micro Reactor Plant Design Technology, MMR™ (for typical one reactor Installation)	
Number and type of structures/buildings	Nuclear Plant: (2 Buildings) Citadel: Set below grade concrete module structure that houses the reactor unit Nuclear Building: Prefabricated module structure that houses the control room, reactor services and storage areas (building sizes are based on a specific project and can change based on site characteristics, UIUC deployment will be site specific and may not be pre-fabricated).
Maximum height/elevation of the tallest structure and depth of any underground components	Maximum Height: Stack 100 ft Excavation Depth: Citadel Building [typically 65 ft, but may vary as a result of geotechnical considerations]
Anticipated Emergency Planning Zone (EPZ)	No EPZ beyond Nuclear Plant Fence
Any specific soil conditions required or prohibited, e.g., permafrost	No specific soil conditions are excluded. Final foundation design is completed after site-specific geotechnical investigation and geophysical survey are completed.

6.2 Siting

6.2.1 Completed Siting Studies

In early 2020, UIUC entered into a partnership agreement with USNC to plan, license and operate an MMR™ as an RTR at UIUC. The overall goal of the project is to deploy an MMR™ at UIUC by mid-to-late 2020s, closely following the expected deployment and start-up of the first MMR™ unit at Canadian Nuclear Laboratories, Canada. The pre-application (Vendor Design Review or VDR) process and the preparation of an Environmental Assessment (EA) to support an application for License to Prepare Site (LTPS) is underway with the Canadian Nuclear Safety Commission (CNSC).

To date, UIUC has conducted numerous engagement activities to raise awareness of the project and has gained support from the university, surrounding public, and state and federal stakeholders. UIUC has performed initial evaluations for siting and integration of a microreactor for testing, research, training, and production demonstration. These assessments included an initial siting assessment with the Oak Ridge Siting Analysis for power Generation Expansion (OR-SAGE) tool [8], and an in-depth study through Middough Inc. [9] of construction requirements and integration of the MMR™ unit with the existing campus facilities and power plant.

The scope of the study performed by Middough Inc. included the geological excavation required for the below grade reactor installation, reactor building and adjacent plant layout, the integration of the adjacent plant with the existing Abbott Power Plant for delivery of steam and feedwater return, and the refurbishment or new construction of a co-located microreactor education and research center. The preliminary engineering assessment cited no major construction challenges or issues related to integration with existing facilities.

The scope of this Plan is limited to completing all regulatory requirements with the USNRC to obtain a Construction Permit (CP) under 10CFR50 regulations for RTRs. Subsequent follow-on regulatory activities necessary for deployment, i.e., obtaining a USNRC operating license is not in the scope of the current application being planned for submittal herein, however the application schedule includes an indicative timeframe for future follow-on regulatory engagement towards deployment.

6.2.2 Preparation of Environmental Assessment

Working with USNRC guidelines, subject matter experts from UIUC, AECOM and other specialists on the team will develop and prepare the required Environmental Reports (ER) for the proposed site. The subject matter experts will collect and evaluate the sufficiency of the existing data relevant to the resource areas. An annotated outline will be prepared, and information needs will be identified. It is anticipated that some baseline field studies will need to be conducted and reports will need to be prepared; these studies include baseline noise studies, a traffic study, and various confirmatory visits.

A Cultural Resources Survey and a Historic Architecture Survey may also be required. In addition, due to the age of the UIUC campus (founded in 1867), the ER will need to consider the Historic Architecture context of the University and any impacts associated with construction and demolition activities. The ER will include criteria and justification relating to the site selection process and alternatives.

The ER and Chapter 2 of the PSAR will be prepared accordingly.

6.3 Quality Assurance

A Quality Assurance Program Document (QAPD) for the Project will be prepared and submitted for USNRC review. The QAPD will identify the elements of USNC's ASME NQA-1 requirements that are to be implemented for the design and analyses of the MMR structures, systems and components (SSC) for the RTR licensing project. The QAPD will include a discussion of how the applicable requirements of 10 CFR 50 Appendix B will be satisfied and implemented, and where a graded approach will be followed. Commercial Grade Dedication (CGD) will be considered where justified and in conformance with applicable NQA-1 guidelines. In addition, reviews and audits of subcontractor QA programs will be conducted to verify that the subcontractors have acceptable QA programs and can perform work in accordance with the applicable QA requirements.

The QA program for the various phases of this project will include requirements for a construction work plan and contractor management and oversight during the execution of project related work.

7 REGULATORY STRATEGY

7.1 Pre-Application Submittal Regulatory Engagement

7.1.1 Public and Non-Public Meetings

The applicant team expects to maintain open and frequent coordination with the USNRC staff and other stakeholders by participating in meetings and discussions during the licensing process to maintain consistent understanding about the project status. Non-public drop-in meetings will be used for general non-technical discussions about process and planning. Public meetings will be utilized for technical discussion related to the licensing application submittal and for response to submitted white paper, technical reports, and topical reports.

7.1.2 Topical Reports

UIUC and the reactor vendor USNC will prepare several Topical Reports (TR) for early submission and review by the NRC. Proposed topics include:

- Safety Classification Methodology
- Fuel Qualification Methodology
- Source Term Analysis Methodology
- Source Term Code V&V
- Safety Analysis Methodology
- Safety Analysis Code V&V
- MMR Instrumentation & Control System Architecture

Once the TRs are submitted, UIUC will respond to Requests for Additional Information (RAIs) from USNRC staff on the content of the submittals. If other submittals, either as TRs, White Papers or Technical Reports are deemed to be necessary for the conduct of USNRC's pre-application review of the proposed project, they will be discussed and prepared for staff review.

7.1.3 Site Visits

During the licensing process, UIUC and the vendor USNC would welcome site visits by the USNRC staff, whenever required, for smooth progress and timely resolution of safety concerns identified during the review of the application documentation. Pre-application site visits and audits can be supported as needed by the USNRC and any other regulatory body.

7.1.4 Site Specific Issues and Environmental Assessment

An important part of the licensing process is the review of site characteristics to verify impact of reactor operation on the environment and vice versa. The applicant team expects to have discussions with the USNRC staff during pre-application phase to ensure all requirements for a complete environmental review are met. The applicant team is currently following the Chapter 19 "Environmental Review" Interim Staff Guidance (ISG) based on NUREG-1537 Parts 1&2 as compliance for 10 CFR 51.20. In addition, the applicant team intends to work closely with the USNRC staff to confirm appropriate site data needed for the Environmental Impact Statement (EIS).

Given the intended use of the reactor system to demonstrate the ability of the microreactor to integrate with existing power generation infrastructure, the preliminary sites under consideration are directly adjacent to the campus's Abbott Power Plant. The applicant team has conducted regular meetings with the Illinois Emergency Management Agency (IEMA) who have provided UIUC with a summary of the applicable state statutes and regulations based on the current project plans [10]. Additional clarification and engagement with the various state and federal agency jurisdictions over the project scope will be sought early in the USNRC pre-application process.

7.1.5 Proposed CP Application – Overview of Chapters (NUREG 1537) with particular focus on CP related content

A significant portion of the initial NUREG-1537 format PSAR is proposed to be obtained from documentation that is already under development by USNC, and that will be significantly advanced to benefit the PSAR for preparation under NUREG-1537 format and content guidance. Revisions to address gaps, details specific to NUREG-1537 guidance, and site specific aspects will be developed, as needed, to provide a complete PSAR for USNRC review. In this regard, key main focus areas are expected to be site specific analyses, the use of USNRC endorsed codes and standards, documenting the accident analyses and codes used for modeling in accordance with USNRC guidance.

Attachment 1 lists which chapters in NUREG-1537 will be prepared as part of the PSAR to allow USNRC to issue a CP, their key content topics, and shows which chapters will be added later as part of the Final Safety Analysis Report (FSAR) in order to obtain a commissioning and operating license.

7.1.6 Pre-Application Readiness Assessment

Prior to submission, UIUC will engage with the USNRC staff to conduct a pre-application readiness assessment of both the safety and environmental aspects of the application. The results of the assessment will be used to finalize the application and assist USNRC staff with planning and resource allocation for the application review.

7.2 Post-Application Submittal Regulatory Engagement

As described in Section 3, post-application engagement with the USNRC staff will include, but not limited to:

- Responding to Requests for Additional Information (RAIs) in a timely manner,
- Support for additional USNRC meetings that may be required in support of the application
- Providing necessary additional information, upon request, in the preparation of supporting USNRC documents, leading up to the issuance of the Construction Permit.
- Support and participate in public meetings upon request by USNRC project staff.

8 PROPOSED SCHEDULE FOR ISSUANCE OF CONSTRUCTION PERMIT

The proposed CP application licensing schedule has been developed based on the USNRC established generic milestone schedules for license review and is based on an overall 3-year timeframe (refer to Attachment 3). Preapplication activities will be carried out over the initial periods with a strong focus on the preparation of white papers and Topical Reports, as applicable, for review and discussion with USNRC staff. In parallel, the applicant will conduct the environmental review, prepare an EIS and prepare the PSAR. The PSAR will be finalized based on interactions and considerations arising from the Topical Report and white paper engagements with USNRC Staff.

The schedule reflects a period of 24 months for pre-application engagement and 16 months from the application submission to the issuance of a Construction Permit.

The CP application represents the initial phase of the RTR deployment, subsequent phases include the operating license application, detailed design of the UIUC adjacent plant facility and training facility, fuel supply and manufacturing as well as plant construction. The overall schedule is presented in Attachment 3 to this document.

9 REFERENCES

[1] Dr. Susan A. Martinis to Ms. Andrea D. Veil, "Notice of Intent to Submit an Application for a Construction Permit for a Research & Test Reactor," University of Illinois to U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, May 19, 2021.

[2] "DRAFT Pre-application Engagement to Optimize Advanced Reactors Application Reviews," ML21145A106, May 2021.

[3] NUREG-1537, "Guidelines for Preparing and Reviewing Applications for the Licensing of a Non-Power Reactor" Part 1, Format and Content, February, 1996.

[4] Interim Staff Guidance Augmenting NUREG-1537, Part 1," ML12156A069, October, 2012

[5] *"Licensing Plan for the Standard MHTGR,"* DOE Report HTGR-85-001/A, Issued by Gas Cooled Reactor Associates, November, 1986.

[6] "Modular HTGR Safety Basis and Approach," prepared by Idaho National Laboratory for the U.S. Department of Energy, INL/EXT-11-22708, August 2011.

[7] *"Pre-Conceptual Design of a High Temperature Teaching and Test Reactor (HT3R): Technical and Design Plan,"* prepared for The Regents of the University of Texas System by General Atomics, PC-000539/0, December 22, 2006.

[8] "Updated Application of Spatial Data Modeling and Geographical Information Systems (GIS) for Identification of Potential Siting Options for Small Modular Reactors," Oak Ridge National Laboratory, ORNL/TM-2012/403, September, 2012.

[9] *"Abbot Power Plant: Micro-Reactor Research Reactor Feasibility Study,"* Final Report, Rev. C , UIC Project No. 20130, Middough Project Solutions, August 4, 2020.

[10] Correspondence, Kelly Horn, Head of Environmental Management, Division of Nuclear Safety, Illinois Emergency Management Agency (IEMA) to Kathryn Huff, University of Illinois re: University engagement with IEMA to become an early site for a micro-reactor," August 10, 2020.

Attachment 1

Proposed PSAR Contents in accordance with NUREG-1537 Part I Guidance

NUREG-1537/1 Chapter	**Chapter Title**	**Summary of Contents**	**PSAR**	**FSAR[4]**
	Introduction	General Description of document structure, contributors etc.	X	
1	The Facility	1. General Description 2. Principal Safety Considerations Summary 3. Summary of Proposed Operations 4. Shared Facilities 5. Compliance with NWPA	X	X
2	Site Characteristics	Address all required site characteristics shown in NUREG-1537/1 ToC	X	
3	Design of Structures, Systems and Components	1. Design Criteria 2. Meteorological, water and seismic damage considerations in design Systems and Components	X	
4	Reactor Description	1. Summary Description 2. Reactor Core Structure 3. Core Support Structures 4. Reactor Fuel 5. Control Rods 6. Neutron Moderator and Reflector 7. Neutron Startup Source 8. Reactor Vessel 9. Biological Shield 10. Nuclear Design 11. Thermal Hydraulic Design 12. Limiting Conditions of Operations (LCOs)	X	X
5	Reactor Coolant Systems	1. Summary Description 2. Primary Coolant 3. Secondary Coolant 4. Coolant Makeup and Purification Systems, as applicable Auxiliary Systems served by the RCS	X	X
6	Engineered Safety Systems	1. Confinement/Containment 2. RCCS 3. Other	X	X

[4] The FSAR will update the PSAR as necessary based on the final design, and include additional information that is required for the FSAR that is not relevant for the CP application.

NUREG-1537/1 Chapter	Chapter Title	Summary of Contents	PSAR	FSAR[4]
7	Instrumentation & Control Systems	1. Design Criteria and Design Basis 2. Reactor/Reactivity Control System 3. Reactor Protection Systems 4. ECCS Actuation Systems 5. Control Console and Displays 6. Software Description 7. Radiation Monitoring Systems	X	X
8	Electrical Power Systems	1. Normal 2. Emergency	X	X
9	Auxiliary Systems	1. Receipt, handling and storage of reactor fuel 2. Use of byproduct materials 3. Fire Protection System 4. Communication Systems		X
10	Experimental Facilities	1. Summary Description of Planned Experimental Facilities 2. Experiment Reviews	X	X
11	Radiation Protection and Waste Management	1. Radiation Protection and ALARA Program 2. Area Radiation Monitoring and Surveys 3. Radiation Exposure Controls and Dosimetry 4. Radioactive Waste Management Program	X	X
12	Conduct of Operations	1. Organization and Staffing 2. Personnel Selection and Training 3. Reviews and Audits 4. Standard Operating Procedures 5. Security and Emergency Planning 6. Operator Training and Qualification Program 7. Quality Assurance		X
13	Accident Analyses	1. Accident Initiating Events & Scenarios 2. Accident Analysis – deterministic or probabilistic 3. MHA	X	X
14	Technical Specifications	1. Format and Content of Technical Specifications	X	X
15	Financial Qualifications	1. Financial Ability to Construct 2. Financial Ability to Operate 3. Financial Ability to Decommission	X	X
16	Other License Considerations	1. Prior Use of Reactor Components 2. Medical Use of Non-Power Reactors	N/A	N/A
17	Decommissioning & POL Amendments	1. Decommissioning Plan a. Preliminary D-Plan b. Decommissioning Alternatives c. Release Criteria and Final Survey 2. Possession Only License Amendment	X	X

NUREG-1537/1 Chapter	Chapter Title	Summary of Contents	PSAR	FSAR[4]
18	HEU to LEU Conversion	N/A	N/A	N/A
19	Environmental Review	1. Introduction of the Environmental Report 2. Proposed Action 3. Description of the Affected Environment 4. Impacts of Proposed Construction, Operations, and Decommissioning 5. Alternatives 6. Conclusions	X	

Attachment 2

Acronyms and Abbreviations

CP	Construction Permit
FCM®	Fully Ceramic Micro-Encapsulated (a registered trademark of USNC)
HALEU	High Assay Low Enriched Uranium
HIDRA	Hybrid Illinois Device for Research Applications
HTGR	High Temperature Gas Cooled Reactor
IEMA	Illinois Emergency Management Agency
I&C	Instrumentation and Control
MMR™	Micro Modular Reactor (a registered trademark of USNC)
NQA-1	American Society of Mechanical Engineers (ASME) QA Requirements for Nuclear Facility Applications
PSAR	Preliminary Safety Analysis Report
QA	Quality Assurance
QAPD	Quality Assurance Program Document
RTR	Research and Test Reactor
TR	Topical Report
TRIGA®	Training, Research, Isotopes, General Atomics (a registered trademark of General Atomics)
TRISO	TRIstructural ISOtropic
UCO	Uranium Oxycarbide
UIUC	University of Illinois at Urbana-Champaign
USNC	Ultra Safe Nuclear Corporation
V&V	Verification and Validation
USNRC	United States Nuclear Regulatory Commission
w/o	Percent by Weight
WP	White Paper

Attachment 3

Proposed Construction Permit Application Schedule