Attachment 1

North Carolina State University

PULSTAR Reactor

Financial Qualifications Report

1-NOV-2018

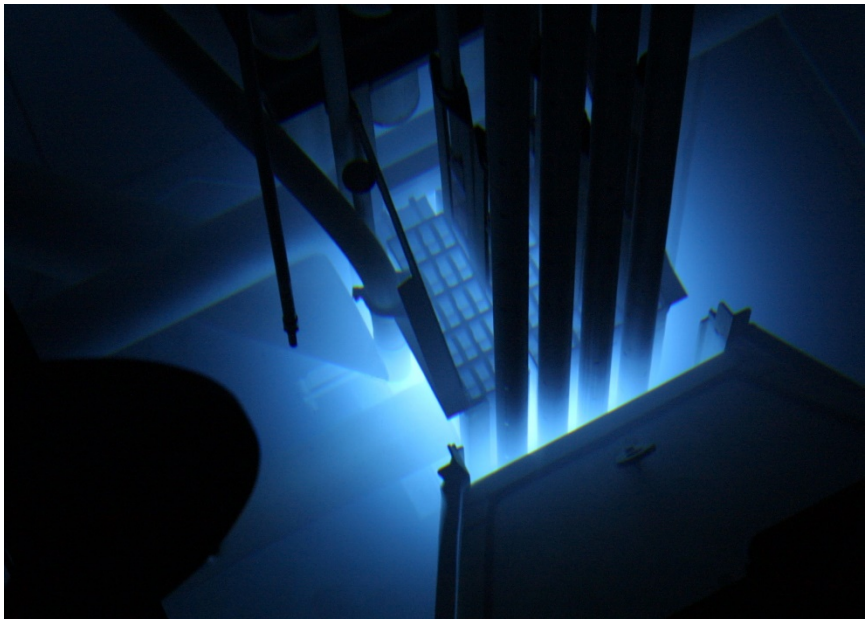
NC STATE UNIVERSITY

PULSTAR REACTOR

FINANCIAL QUALIFICATIONS REPORT

NORTH CAROLINA STATE UNIVERSITY

RALEIGH, NORTH CAROLINA 27695



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Attachment 1 North Carolina State University Annual Financial Report 2016

Attachment 2 Statement of Intent (SOI) Regarding Decommissioning Funding for the PULSTAR Reactor Facility at NC State University

1. INTRODUCTION

This Financial Qualifications Report is submitted pursuant to the requirements of 10 CFR 50.33, 10 CFR 50.71, and 10 CFR 50.75. Pursuant to 10 CFR 50.33(f)(2), none of the provisions of 10 CFR 50.33(d) apply. The applicant is a government institution of the State of North Carolina. Pursuant to 10 CFR 50.71(b), a copy of the most recent financial statement for North Carolina State University is appended to this report. Please reference Attachment 1, *North Carolina State University Annual Financial Report 2016*.

2. ANNUAL FUNDING AND OPERATING EXPENDITURES

Pursuant to 10 CFR 50.33(f)(2), the estimated annual funding for the first 5 year period after the projected license renewal are given in Table 1. The annual operating expenditures for the first 5 year period after the projected license renewal are given in Table 2. As indicated below, the projected annual funding levels of the reactor facility are equal to the projected annual operating expenditures.

Pursuant to the requirements of 10 CFR 50.21(c) and 10 CFR 50.22 concerning a class 104(c) research facility, no more than 50 percent of the annual cost of owning and operating the PULSTAR facility is devoted to the production of materials, products, or energy for sale or commercial distribution, or to the sale of services, other than research and development or education or training.

Table 1 – PULSTAR Reactor Facility Annual Funding

Fiscal Year	2018	2019	2020	2021	2022
State Budget Allocation [2]	$532,800	$538,100	$543,500	$548,900	$554,400
Services Cost Recovery [3]	$418,700	$428,300	$438,200	$448,300	$458,600
Federal Contracts and Grants [4]	$1,303,800	$1,333,800	$1,364,500	$1,395,900	$1,428,000
Total Funding	$2,255,300	$2,300,200	$2,346,200	$2,393,100	$2,441,000

Table 2 – PULSTAR Reactor Facility Annual Operating Expenditures

Fiscal Year	2018	2019	2020	2021	2022
Total Personnel [5]	$1,273,800	$1,303,100	$1,333,100	$1,363,700	$1,395,100
Total Operating and F&A[6]	$981,500	$997,100	$1,013,100	$1,029,400	$1,045,900
Total Expenditures	$2,255,300	$2,300,200	$2,346,200	$2,393,100	$2,441,000

Bases and Assumptions:

1. The budgeted figures detailed in the tables above represent likely funding and expenditures for the specified fiscal years (which run from July 1 of the preceding year through June 30 of the year indicated). Expenses are projected to increase at an estimated 2.3% annual rate of inflation.
2. The state allocation is provided via NC State University's 2-15461 account and is estimated for

future years based on a 1% rate of growth.

3. Operating funds required over-and-above the annual state allocation are provided by reactor services revenue and are budgeted for reactor operating expenditures via the university trust account 3-76676.
4. Federal funding for the development of experimental capabilities has been included in these budget estimates. The development of experimental capabilities is funded through sponsored research programs.
5. The budget estimate for 'Personnel' includes salaries and wages for all facility administrative, operating and research staff, graduate students, and student reactor operators.
6. The estimates for total Operating and Facilities and Administrative (F&A) costs include all direct and in-direct (non-personnel) costs of operating and supporting the reactor facility.

3. DECOMMISSIONING REPORT

Pursuant to 10 CFR 50.33(k) and 10 CFR 50.75(d), the following is a decommissioning report containing the following:

1) Cost estimate for decommissioning the facility.
2) Indication of the funding method to be used to provide funding assurance for decommissioning.
3) A means of adjusting the cost estimate and associated funding level periodically over the life of the facility.

3.1. Decommissioning Cost Estimate

3.1.1. PULSTAR Decommissioning Cost as based on 1988 Estimate

In the North Carolina State University *Statement of Financial Qualifications* letter dated July 1, 1988[1], the cost estimate for decommissioning the NC State PULSTAR was given as approximately $800,000 to $1,000,000 dollars. The basis provided for this estimate was "the experience at North Carolina State University in decommissioning the 10 kW MTR type reactor (license # R-3) in 1980 and from discussions with reactor personnel from both the University of Texas at Austin 100 kW reactor (being relocated to a new building off-campus) and the University of California at Berkeley 1 MW reactor (being permanently shutdown)". The estimate included removal of all activated reactor components, demolition of the reactor biological shield, and disposal costs for radioactive materials. It did not include salaries of PULSTAR reactor personnel contributing to the decommissioning effort, or costs associated with demolition of the reactor high bay (it was assumed the high bay would be renovated and re-used). Applying the methodology of NUREG-1307 Rev 15 *Report on Waste Burial Charges; Changes in Decommissioning Waste Disposal Costs at Low-Level Waste Burial Facilities*[2], and using the 1988 estimate of $1M as a basis, the cost for decommissioning the NC State PULSTAR would be projected to be $4.8 million in 2017 dollars.

3.1.2. Comparison with recent representative decommissioning projects

Per NUREG 1537 Part 1 *Guideline for Preparing and Reviewing Applications for the Licensing if Non-Power Reactors – Format and Content* Section 15.3[3], as an additional basis for estimating the decommissioning costs of the PULSTAR Reactor, actual recent decommissioning costs from two

representative reactor facilities are considered:

1) The Ford Reactor at the University of Michigan, decommissioning completed in 2015, at an actual cost of $14.4 million. The 2 MW reactor structure and associated experimental facilities were decommissioned and removed, but the reactor building was left in place. The bulk of the deconstruction activity and low level radioactive waste shipments occurred in 2007. This information was obtained in discussions with officials from the reactor facility at the University of Michigan.

2) The PULSTAR Reactor Facility at SUNY Buffalo, decommissioning completed in 2015, at an actual cost of $14.1 million. The entire reactor facility, including the 2 MW reactor structure, containment building, and associated administrative building was decommissioned and removed. The bulk of the deconstruction activity and low level radioactive waste shipments occurred in 2014. This information was obtained in discussions with officials from the reactor facility at SUNY Buffalo.

The two reactors referenced resided in states that were not members of a radioactive waste compact at the time the facilities were decommissioned. The low level radioactive waste from the deconstruction and decommissioning of these facilities was shipped to the LLW disposal facility in Clive, Utah. This would also be the case for the PULSTAR reactor, as the State of North Carolina is also not currently part of a waste compact.

Applying the methodology of NUREG-1307[2] and using the known costs of the two representative reactor facility decommissioning efforts as bases, cost estimates for decommissioning these facilities in 2017 dollars are given in Table 3 below.

Table 3 – Estimated 2017 Decommissioning costs for two representative research reactors

Reactor Facility	Primary Year of Deconstruction	Total Actual Cost	Labor Adj. L_x	Energy Adj. E_x	Waste Burial Adj. R_x	Estimated 2016 Decom. Cost[1]	Corrected 2017 Decom. Cost[2]
Ford Reactor	2007	$14.4M	1.192	0.796	1.317	$16,800,000	$17,100,000
Buffalo PULSTAR	2014	$14.1M	1.047	0.892	1.011	$14,400,000	$14,600,000

1: The estimated decommissioning cost is corrected from the primary year of deconstruction to 2016 based on the formulas of NUREG-1307 Section 3[2] and applying the labor, energy, and waste burial correction factors as given.

2: The Corrected 2017 Decommissioning Cost is calculated by applying an Organization for Economic Cooperation and Development (OECD) projected 2017 U.S. inflation factor of 1.9%[4].

3.1.3. Discussion of Costs

The PULSTAR decommissioning estimate derived from the assumptions in 1988 (as detailed in section 2.1.1) is inconsistent with the estimates obtained in section 2.1.2 from recent representative RTR decommissioning projects. The estimates from the recent representative RTR decommissioning projects are considered to have stronger bases than the dated estimate from 1988, so will form the basis for the updated estimate for the NC State PULSTAR Facility.

Out of the two cases studied, the decommissioning of the Buffalo PULSTAR is considered the most representative relative to the NC State PULSTAR reactor based on the following factors:

1) The facilities were both built with 2 story reactor bio-shields containing beam-ports, and similarly configured primary and secondary cooling systems with N-16 delay tanks and shield vaults. Both facilities were built within a high bay with an internal crane, and containing an experimental beam floor.

2) The Buffalo reactor containment building was removed as part of decommissioning; it is anticipated that the NC State PULSTAR confinement building would be decommissioned as well.

3) The decommissioning of the Ford Reactor at the University of Michigan did not include the removal of the reactor building. Significant additional costs were incurred given the logistics of deconstructing the reactor facility without removing the surrounding building. This approach differs significantly from the anticipated approach for decommissioning the NC State PULSTAR.

4) The Buffalo PULSTAR decommissioning effort differed in several ways from the projected NC State PULSTAR decommissioning effort, all resulting in increased relative costs:

5) The Buffalo facility reactor bio-shield was somewhat more complex and massive, including a hot cell facility and additional exposure caves, leading to additional decommissioning costs.

6) An entire administration building wing was decommissioned and removed as part of the Buffalo project. It is anticipated that the Burlington Laboratory building adjacent to the PULSTAR reactor would not be decommissioned.

7) Significant cost overruns were incurred for the Buffalo project when the NYS DEC required that all of the clean concrete rubble be disposed of out of state, leading to additional shipping costs.

3.1.4. 2017 NC State PULSTAR Decommissioning Estimate:

Given the discussion in 2.1.3 above, it is apparent that the decommissioning cost for the NC State PULSTAR would be very conservatively bounded by the $14.1M cost of the Buffalo PULSTAR decommissioning effort. In reviewing the decommissioning costs of the Buffalo facility, and in discussions with the Buffalo facility administrative staff, it is reasonable to make the following conservative corrections in adjusting the 2014 Buffalo costs to be consistent with the NC State PULSTAR facility estimate: 1) subtract $1.0M due to cost overruns for out of state disposal of clean concrete rubble, and 2) subtract $0.5M for demolition of the administration building and disposal. This yields an estimated 2014 decommissioning cost of $12.6M for the NC State PULSTAR facility.

Table 4 – Estimated 2017 Decommissioning costs for NC State PULSTAR

Reactor Facility	Primary Year of Deconstruction	Total 2014 Cost	Labor Adj. L_x	Energy Adj. E_x	Waste Burial Adj. R_x	Estimated 2016 Decom. Cost[1]	Corrected 2017 Decom. Cost[2]
Buffalo PULSTAR	2014 *(actual)*	$14.1M	1.047	0.892	1.011	$14,400,000	$14,600,000
NC State PULSTAR	2014 *(basis)*	*$12.6M est.*	1.047	0.892	1.011	$12,800,000	$13,100,000

Applying the methodology of NUREG 1307[2] (see Table #4 above), the estimate for decommissioning the NC State PULSTAR is $12.8 million in 2016 dollars as corrected from 2014. Applying an Organization for Economic Cooperation and Development (OECD) projected 2017 U.S. inflation estimate of 1.9%[4] to correct from 2016 to 2017 dollars yields an estimated PULSTAR facility

decommissioning cost of $13.1 million in 2017 dollars. This total may be subdivided into labor, materials, and services (65%) at $8.5 million, energy and transportation (13%) at $1.7 million, and waste burial (22%) at $2.9 million. Adding a 25% contingency factor per NRC requirements would increase the total estimated cost to $16.4 million. This estimate assumes that NC State will utilize the DECON method of decommissioning, removing and disposing of all radioactive waste offsite. The estimate does not include salaries of PULSTAR reactor personnel contributing to the decommissioning effort.

3.2. Funding Method

Pursuant to 10 CFR 50.75(e)(1)(iv), North Carolina State University intends to use a Statement of Intent (SOI) as the method to provide decommissioning funding assurance. Please reference Attachment 2: *Statement of Intent (SOI) regarding Decommissioning Funding for the PULSTAR Reactor Facility at NC State University*, dated February 24, 2017[5, 6].

3.3. Adjustment of Decommissioning Cost Estimate

The 2016 Decommissioning cost estimate for the NC State PULSTAR Reactor Facility is $12.8 million as detailed in section 1.4 above. This estimate will be updated periodically as required using the methodology described in NUREG 1307[2] and detailed below:

From NUREG 1307 Section 3: Estimated Cost (Year X) = (2016 $ Cost)*(ALx + BEx + CBx)

Where: 2016 $ Cost = $12.8 million

A = Labor fraction (65%)

B = Energy fraction (13%)

C = Burial fraction (22%)

Lx = Labor Cost adjustment (REF BLS Code CUI2010000000220I for South region)

Ex = Energy Cost adjustment

Px = Industrial Electric Power Index (REF BLS Code WPU0543)

Fx = Light Fuel Oils Index (REF BLS Code WPU0573)

Bx = Burial Cost adjustment (REF NUREG 1307 Table 2-1)

Adjustment factors would be calculated as follows (as referenced to 2016 Bureau of Labor Statistics Labor and Producer Price Indices[7]:

Lx = Average ECI (South for Year X) / Average ECI (South for 2016)

= Average ECI (South for Year X) / 125.7

Ex = 0.58Px + 0.42Fx (PWR)

Where:

Px = (Average Year X value of code 0543) / (Average 2016 value of code 0543)

Px = (Average Year X value of code 0543) / 214.1

Ex = (Average Year X value of code 0573) / (Average 2016 value of code 0573)

Ex = (Average Year X value of code 0573) / 134.5

Bx = Table 2-1 Value for Generators in Unaffiliated States (PWR Year X) / (PWR 2016)

= Table 2-1 Value for Generators in Unaffiliated States (PWR Year X) / 12.471

4. REFERENCES

1 Statement of Financial Qualifications Letter, July 1, 1988, North Carolina State University, https://www.nrc.gov/docs/ML1513/ML15134A200.pdf

2 Report on Waste Burial Charges; Changes in Decommissioning Waste Disposal Costs at Low-Level Waste Burial Facilities, NUREG-1307, REV. 15, U.S. Nuclear Regulatory Commission, January 2013; https://www.nrc.gov/docs/ML1302/ML13023A030.pdf

3 Guideline for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors – Format and Content, NUREG 1537 Part 1, U.S. Nuclear Regulatory Commission, February 1996; https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1537

4 Organization for Economic Cooperation and Development (OECD) 2017 U.S. Inflation Forecast; https://data.oecd.org/price/inflation-forecast.htm

5 North Carolina General Statutes – Chapter 116, Higher Education, Article 1, University of North Carolina; http://www.ncga.state.nc.us/enactedlegislation/statutes/html/bychapter/chapter_116.html

6 North Carolina State University Regulation 01.20.02, Delegation of Authority to Sign Contracts, REV. March 29, 2016; https://policies.ncsu.edu/regulation/reg-01-20-02/

7 2016 Bureau of Labor Statistics Labor and Producer Price Index; http://www.bls.gov/data/