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# Attachment 1: Statement of Work

# Attachment 2: Contractor's Spending Plan

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# TASK ORDER TERMS AND CONDITIONS

NOT SPECIFIED IN THE CONTRACT

#### A.1 PRICE/COST SCHEDULE

BASE PERIOD	Date of award through Augus DESCRIPTION OF SUPPLIES/SERVICES	C31,2016 ESTIMATED GOST	FIXED PEE	
001	Services described in the attached Statement of Work (SOW)			
		Total		\$251,694.41

# A.2 CONSIDERATION AND OBLIGATION--COST-PLUS-FIXED-FEE (AUG 2011) ALTERNATE I (AUG 2011)

(a) The total estimated cost to the Government for full performance of this contract is \$251,694.41, of which the sum of the represents the estimated reimbursable costs, and of which the fixed-fee.

(b) There shall be no adjustment in the amount of the Contractor's fixed fee.

(c) The amount currently obligated by the Government with respect to this contract is \$52,000.00 of which the sum of represents the estimated reimbursable costs, and of which presents the fixed-fee.

(d) It is estimated that the amount currently obligated will cover performance through May 4, 2013.

(e) This is an incrementally-funded contract and FAR 52.232-22 - "Limitation of Funds" applies.

(f) In accordance with FAR 52.216-8 - Fixed Fee, it is the policy of the NRC to withhold payment of fee after payment of fee after payment of fee after payment of the fee has been paid in order to protect the Government's interest. The amount of fixed-fee withheld from the contractor will not exceed ercent of the total fee or whichever is less. Accordingly, the maximum amount of fixed-fee that may be held in reserve is

#### A.3 TASK/DELIVERY ORDER PERIOD OF PERFORMANCE (AUG 2011)

This order shall commence on date of award and will expire on August 31, 2016.

#### A.4 COMPLIANCE WITH U.S. IMMIGRATION LAWS AND REGULATIONS (AUG 2011)

NRC contractors are responsible to ensure that their alien personnel are not in violation of United States immigration laws and regulations, including employment authorization documents and visa requirements. Each alien employee of the Contractor must be lawfully admitted for permanent residence as evidenced by Permanent Resident Form I-551 (Green Card), or must present other evidence from the U.S. Department of Homeland Security/U.S. Citizenship and Immigration Services that employment will not affect his/her immigration status. The U.S. Citizenship and Immigration Services provides information to contractors to help them understand the employment eligibility verification process for non-US citizens. This information can be found on their website, http://www.uscis.gov/ portal/site/uscis.

The NRC reserves the right to deny or withdraw Contractor use or access to NRC facilities or its equipment/services, and/or take any number of contract administrative actions (e.g., disallow costs, terminate for cause) should the Contractor violate the Contractor's responsibility under this clause.

#### A.5 CONTRACTOR ACCEPTANCE OF TASK ORDER NRC-HQ-13-T-04-0002

Acceptance of Task Order No. NRC-HQ-13-T-04-0002 should be made by having an official, authorized to bind your organization, execute two copies of this document in the space provided and return one copy to the Contracting Officer. You should retain the other copy for your records.

Accepted Task Order No. NRC-HQ-13-T-04-0002:

Page 3

#### STATEMENT OF WORK

**CONTRACT NO.** NRC-HQ-12-C-04-0087

2

TASK ORDER NO.

TITLE: Level 2 PRA Logic Model Technical Support

# 1.0 BACKGROUND

The probabilistic logic model (plant damage state binning, accident progression event trees, fault trees, split fractions, etc.) is used to track and quantify the severe accident sequences that comprise the Level 2 Probabilistic Risk Assessment (PRA), leading to the release frequencies and source terms that serve as the starting point for the Level 3 portion of the overall PRA. Development of this logic model requires detailed knowledge of probabilistic modeling, the plant response to beyond-design basis accidents, accident management, and severe accident phenomenology. The Level 2 PRA logic model is the framework that brings these disparate pieces together.

# 2.0 TASK ORDER OBJECTIVE

The objective of this Task Order is to support the development of the probabilistic aspects of the reactor Level 2 portion of the Full-Scope Site Level 3 PRA Project by addressing the interface (transfer and handling of information) between the Level 1 and Level 2 PRA, developing and quantifying the Level 2 logic model (event trees, etc.), and contributing to the evaluation and presentation of results.

#### 3.0 SCOPE OF WORK

The contractor shall provide support for the development of the Level 2 portion of the full-scope site Level 3 PRA starting with the Vogtle Systems Analysis Programs for Hands-on Integrated Reliability Evaluations (SAPHIRE) Level 1 reactor model being developed under a separate contract, and bringing to bear the contractor's extensive knowledge of Level 2 PRA modeling issues. The contractor shall provide support for the development of the Level 2 PRA logic model which shall include, but is not limited to: 1) reviewing past Level 2 PRA logic models for nuclear power plants; 2) formulating a position of how the model should be structured and how it will function; 3) becoming familiar with the capabilities of the SAPHIRE computer code, which will be used to develop the Level 2 PRA logic model; 4) interfacing with the teams performing the Level 1 and Level 3 PRA modeling; 5) formulating positions about what phenomena need to be addressed for the selected plant site (e.g., see Table 2-2.8-9 on page 110 in ASME/ANS RA-Sa-2009); and 6) supporting construction, quantification, and interpretation of the results of the Level 2 PRA logic model. The contractor shall document its activities supporting the Level 2 PRA logic model development in a manner that facilitates PRA applications, upgrades, and peer review.

# 4.0 SPECIFIC TASKS

# 4.1- Task 1: Internal Hazards Level 2 PRA Logic Modeling

**Requirements:** The contractor shall support the U. S. Nuclear Regulatory Commission (NRC) staff in the development of the Level 2 reactor PRA model by performing work that includes, but is not limited to the following:

- Developing extended Level 1 event trees
- Developing plant damage state binning
- Reviewing the resulting plant damage states to ensure dependencies and other information have been adequately transferred
- Establishing criteria for, and selection of, representative sequences for each plant damage state bin

Attachment 1 Page 1 of 6

- Construction of accident progression event trees
- Development of support trees (e.g., fault trees, decomposition event trees)
- Level 2 logic model quantification
- Evaluation and presentation of results
- Level 2/3 PRA interface

Other aspects of the Level 2 modeling (e.g., human reliability analysis, SCALE analysis) and some portions of the above aspects will be performed by NRC staff or by NRC contractors. The contractor's support is needed to: (i) provide unique perspectives to the work, and (ii) ensure consistency with the deterministic underpinnings which the contractor will be developing under a separate task order. This support may also include, but is not limited to, participation in relevant ACRS meetings and technical meetings and discussions with staff on issues surrounding the work described.

The needed analyses or review associated with the above listed activities will be identified by the NRC Contracting Officer Representative (COR), in coordination with the staff in the Office of Nuclear Regulatory Research (RES) that are performing related in-house analysis. Following the identification of a given piece of analysis or review work, which falls under the scope of work described above, the NRC COR will submit a support request to the contractor for review and initiation of work.

**Standard:** All deliverables shall be provided on time to the NRC COR and NRC Contracting Officer (CO). The contractor shall document its activities supporting the Level 2 PRA logic model development in a manner that facilitates PRA applications, upgrades, and peer review.

**Deliverable:** For each requested support item, the contractor shall provide documentation that is consistent with the internal hazards reactor Level 1 PRA. In general, this documentation shall, at a minimum, include: 1) a brief description of the work performed; 2) a list of key assumptions and (if applicable) dependencies with other parts of the PRA model; 3) any quantitative values or logic models developed; and 4) identification of uncertainties. This documentation will be provided via letter report within 2 weeks of the contractor's review of the submitted support request, and will be integrated in to the overall Level 2 PRA documentation.

# 4.2 Task 2: External Hazards Level 2 PRA Logic Modeling

**Requirements:** The work under this Task is analogous to the work under Task 1 in Section 4.1 of this SOW (so far as it related to the work under this contract), and is applied to external hazards (seismic events, high winds, etc.), with the following exceptions (Note: these exceptions may also apply to the treatment of internal fires in Task 1):

- The Level 1 model will need to be re-visited to address conservatisms or non-conservatisms that are unduly affecting the Level 2 results.
- Model quantification is expected to require less relative effort, while uncertainty characterization may require more novel effort.

The list of tasks is repeated below for completeness:

- Developing extended Level 1 event trees
- Developing plant damage state binning
- Reviewing the resulting plant damage states to ensure dependencies and other information have been adequately transferred
- Establishing criteria for, and selection of, representative sequences for each plant damage state bin

Attachment 1 Page 2 of 6

- Construction of accident progression event trees
- Development of support trees (e.g., fault trees, decomposition event trees)
- Level 2 logic model quantification
- Evaluation and presentation of results
- Level 2/3 PRA interface

The needed analyses or review associated with the above listed activities will be identified by the NRC COR, in coordination with RES staff that are performing related in-house analysis. Following the identification of a given piece of analysis or review work which falls under the scope of work described above, the NRC COR will submit a support request to the contractor for review and initiation of work. This support may also include, but is not limited to, participation in relevant ACRS meetings and technical meetings and discussions with staff on issues surrounding the work described.

**Standard:** All deliverables shall be provided on time to the NRC COR and NRC CO. The contractor shall document its activities supporting the Level 2 PRA logic model development in a manner that facilitates PRA applications, upgrades, and peer review.

**Deliverable:** For each requested support item, the contractor shall provide documentation that is consistent with the external hazards reactor Level 1 PRA. In general, this documentation shall, at a minimum, include: 1) a brief description of the work performed; 2) a list of key assumptions and (if applicable) dependencies with other parts of the PRA model; 3) any quantitative values or logic models developed; and 4) identification of uncertainties. This documentation will be provided via letter report within 2 weeks of the contractor's review of the submitted support request, and will be integrated in to the overall Level 2 PRA documentation.

#### 4.3- Task 3: Low-Power & Shutdown Level 2 PRA Logic Modeling

**Requirements:** The actual tasks to be performed are analogous to those listed under Task 1, except that they are applied to low-power and shutdown modes of operation for the work under this task. These activities are repeated below for completeness:

- Developing extended Level 1 event trees
- Developing plant damage state binning
- Reviewing the resulting plant damage states to ensure dependencies and other information have been adequately transferred
- Establishing criteria for, and selection of, representative sequences for each plant damage state bin
- Construction of accident progression event trees
- Development of support trees (e.g., fault trees, decomposition event trees)
- Level 2 logic model quantification
- Evaluation and presentation of results
- Level 2/3 PRA interface

The exceptions cited under Task 2 also apply here. Examples of the types of differences that arise when modeling accidents at shutdown conditions are: 1) situations where containment is in an open status and require more manual activity to isolate; 2) instances where the vessel head is removed and air ingress (and associated differences in cladding oxidation and fission product speciation) are of relevance; and 3) situations where the reactor refueling cavity and reactor vessel are hydraulically connected to the spent fuel pool. This support may also include, but is not limited to, participation in relevant ACRS meetings and technical meetings and discussions with staff on issues surrounding the work described.

Attachment 1 Page 3 of 6

The needed analyses or review associated with the above listed activities will be identified by the NRC COR, in coordination with RES staff that are performing related in-house analysis. Following the identification of a given piece of analysis or review work which falls under the scope of work described above, the NRC COR will submit a support request to the contractor for review and initiation of work.

**Standard:** All deliverables shall be provided on time to the NRC COR and NRC Contracting Officer (CO). The contractor shall document its activities supporting the Level 2 PRA logic model development in a manner that facilitates PRA applications, upgrades, and peer review.

**Deliverable:** For each requested support item, the contractor shall provide documentation that is consistent with the low power and shutdown reactor Level 1 PRA. In general, this documentation shall, at a minimum, include: 1) a brief description of the work performed; 2) a list of key assumptions and (if applicable) dependencies with other parts of the PRA model; 3) any quantitative values or logic models developed; and 4) identification of uncertainties. This documentation will be provided via letter report within 2 weeks of the contractor's review of the submitted support request, and will be integrated in to the overall Level 2 PRA documentation.

# 5.0 TECHNICAL AND OTHER SPECIAL QUALIFICATIONS REQUIRED

This Task Order requires in-depth knowledge and expertise in the development of the Level 2 PRA logic modeling aspects associated with the development of a full-scope site Level 3 PRA for a nuclear power plant (NPP). This in-depth knowledge and expertise includes, but is not limited to, the following areas:

- NPP Accident Analysis Expertise:
  - o NPP design and operation
  - o NPP response to accident initiators and mitigating system behavior
  - o NPP severe accident phenomena
- Level 2 PRA Logic Modeling
  - o Development of Level 2 PRA plant damage state bins and event trees
  - Development of supporting fault trees, phenomenological sub-trees, and split fractions / conditional probabilities
  - o Incorporation of SSC fragility information
  - o Development of source term release categories

Contractors shall be technically creditable to respond to technical questions during presentations to the Advisory Committee on Reactor Safeguards. The contractor's technical credibility will be based on their in-depth knowledge of NPP severe accident progression modeling resulting from their education and work experience.

If a site visit becomes necessary for the work under this Task Order, the contractor staff may need to complete the NRC's site access training. The NRC COR will facilitate this training completion, along with attaining the necessary site access authorization for escorted nuclear power plant access.

The labor categories anticipated for this project are listed below with their descriptions:

# Senior Engineer/Analyst (or equivalent)

Individuals that are proposed to work under this labor category shall posses a minimum of 10 years of technical experience and 5 years of project management experience. The minimum educational requirements are a Ph.D. or Master's degree in a recognized engineering or scientific field from an accredited program of study. Equivalent experience in a science or engineering field may be considered. These individuals shall also have multiple scientific publications and have extensive peer recognition as an authority in his/her field of study.

Attachment 1 Page 4 of 6

Technical experience shall consist largely of the in-depth knowledge and expertise discussed in the first paragraph of this section ("Technical and Other Special Qualifications Required"), and should also include technical experience with applied research, technical analysis, technical support activities, and independent problem solving. Project management experience shall include experience with directing work under technical projects and with multiple personnel. Experience with directing NPP thermal hydraulic (T-H) or severe accident progression modeling projects is preferred.

#### **Engineer/Analyst (or equivalent)**

Individuals that are proposed to work under this labor category shall posses a Bachelor's or Master's degree of Science in addition to the specific technical experience described in the next paragraph. The academic degree shall be for a recognized engineering or scientific field from an accredited program of study. An Engineer/Analyst is expected to perform detailed T-H or severe accident progression modeling and analysis with some direction from the Senior Engineer/Analyst, but should posses enough understanding of the work involved to make independent technical decisions.

Technical experience shall, at a minimum, consist of familiarity with performing detailed T-H or severe accident progression modeling and analysis. Specifically, this familiarity should include: 1) at least 5 years of experience with severe accident progression modeling and analysis, of which at least 2 years of this experience should include the use of the MELCOR computer code and analysis of MELCOR results; and 2) a significant understanding of the technical areas listed in the first paragraph of this section ("Technical and Other Special Qualifications Required").

# 6.0 DELIVERABLES/SCHEDULES AND/OR MILESTONES

All deliverables shall be delivered in electronic format, via email, to the NRC COR and CO by the date specified in the work item delivery schedule.

Milestone/Deliverable	Due Date	Responsibility
Task 1 – The contractor shall provide a letter report for each support request under this task.	Within 2 weeks after the contractor's review of the given support request.	Contractor
Task 2 – The contractor shall provide a letter report for each support request under this task.	Within 2 weeks after the contractor's review of the given support request.	Contractor
Task 3 – The contractor shall provide a letter report for each support request under this task.	Within 2 weeks after the contractor's review of the given support request.	Contractor
NRC Review and Comment	Within 4 weeks of receipt of a contractor letter report, as needed.	NRC COR
Final Trip Report	Within 2 weeks after the conclusion of the trip.	Contractor

Attachment 1 Page 5 of 6

#### 7.0 PERIOD OF PERFORMANCE

Task Order Start Date: Award date of Task Order Task Order End Date: August 31, 2016

#### 8.0 REPORTING REQUIREMENTS

Required deliverables are outlined in Section 4 of this Statement of Work. All deliverables shall be submitted electronically, via email, to the NRC COR and CO. A hardcopy of a deliverable shall only be provided at the request of the NRC COR.

#### 9.0 MEETINGS AND TRAVEL

Meetings that are conducted remotely via teleconference will be held on an as-needed basis. The following travel requirements are anticipated for this Task Order.

- One five-day trip for two people to the subject plant site for information gathering in support of technical analyses.
- Six one-day trips for two people to NRC headquarters in Rockville, MD to discuss project status and technical issues.

#### 10.0 NRC-FURNISHED MATERIAL

The NRC COR will provide all available and necessary plant documentation (Final Safety Analysis Report, Emergency Operating Procedures, Technical Specifications, PRA system notebooks, training materials, past amendment requests). Similarly, access to the Symbolic Nuclear Analysis Package, TRAC/RELAP Advanced Computational Engine, and MELCOR computer codes and the relevant models will be granted within the normal operating constraints for providing this information (e.g., a non-disclosure agreement may be necessary).

In addition, NRC will provide access to agency PRA tools as necessary, and within the constraints placed upon dissemination of the information. The contractor, and any authorized subcontractors, may use NRC Standardized Plant Analysis Risk (SPAR) models and the NRC SAPHIRE PRA computer code to evaluate scenarios. Any problems encountered using the SAPHIRE code or the SPAR models shall be discussed with the NRC COR and documented in the MLSR. The documentation should describe in detail the problem or difficulty encountered and the steps taken to resolve the problem.

The NRC will provide access to the SPAR models and the NRC SAPHIRE PRA computer code. The contractor, and any authorized subcontractors, will use their own personal computers for running SAPHIRE and the SPAR models. The contractor, and any authorized subcontractors, will provide the names, phone numbers, company affiliation, title, mailing address and citizenship of any staff that will need access to the SPAR models. The SPAR models are being provided only for the contractor/subcontractor's use and are not to be distributed further without the written consent of the Nuclear Regulatory Commission. Due to the sensitivity of the information contained in the models, they are not publicly available. Additionally, a non-disclosure agreement must be completed in order to obtain the SAPHIRE computer code. The NRC will also provide Web access to the Accident Sequence Precursor and operating event databases, if necessary. The use of these materials and SPAR models is limited to the period of performance of this contract and to the individuals approved by NRC for access.

Attachment 1 Page 6 of 6

#### **CONTRACTOR SPENDING PLAN – TASK ORDER 2**

Period of Performance: Solicitation No.: Total Estimated Costs: Offeror Name: January 4, 2013 through December 31, 2013 NRC-HQ-12-C-04-0087, Task Order 2 S123,795.20 Energy Research, Inc.

#### Cost Details by Month:

Cost Elements	1st Month	2nd Month	3rd Month	4th Month	5th Month	6th Month
Direct Costs	\$5,879.87	\$5,879.87	\$5,879.87	\$5,879.87	\$5,879.87	\$5,879.87
Indirect Costs	\$4,436.40	\$4,436.40	\$4,436.40	\$4,436.40	\$4,436.40	\$4,436.40
Total Estimated Costs	\$10,316.27	\$10,316.27	\$10,316.27	\$10,316.27	\$10,316.27	\$10,316.27
Project Completion	8%	17%	25%	33%	42%	50%
Cost Elements	7th Month	8th Month	9th Month	10th Month	11th Month	12th Month
Direct Costs	\$5,879.87	\$5,879.87	\$5,879.87	\$5,879.87	\$5,879.87	\$5.879.87
Indirect Costs	\$4,436.40	\$4,436.40	\$4,436.40	\$4,436.40	\$4,436.40	\$4,436.40
Total Estimated Costs	\$10,316.27	\$10,316.27	\$10,316.27	\$10,316.27	\$10,316.27	\$10,316.27
Project Completion	58%	67%	75%	83%	92%	100%

December 2012

NRC-HQ-12-C-04-0087, Task Order Number 2

# CONTRACTOR SPENDING PLAN - TASK ORDER 2

Period of Performance:	January 1, 2014 through December 31, 2014
Solicitation No.:	NRC-HQ-12-C-04-0087, Task Order 2
Total Estimated Costs:	\$71,817.59
Offeror Name:	Energy Research, Inc.

#### Cost Details by Month:

Cost Elements	lst Month	2nd Month	3rd Month	4th Month	5th Month	6th Month
Direct Costs	\$3,350.40	\$3,350.40	\$3,350.40	\$3,350.40	\$3,350.40	\$3,350.40
Indirect Costs	\$2,634.40	\$2,634.40	\$2,634.40	\$2,634.40	\$2,634.40	\$2,634.40
Total Estimated Costs	\$5,984.80	\$5,984.80	\$5,984.80	\$5,984.80	\$5,984.80	\$5,984.80
Project Completion	8%	17%	25%	33%	42%	50%
Cost Elements	7th Month	8th Month	9th Month	10th Month	l 1 th Month	12th Month
Direct Costs	\$3,350.40	\$3,350.40	\$3,350.40	\$3,350.40	\$3,350.40	\$3,350.40
Indirect Costs	\$2,634.40	\$2,634.40	\$2,634.40	\$2,634.40	\$2,634.40	\$2,634.40
Total Estimated Costs	\$5,984.80	\$5,984.80	\$5,984.80	\$5,984.80	\$5,984.80	\$5,984.80
Project Completion	58%	67%	75%	83%	92%	100%

#### **CONTRACTOR SPENDING PLAN – TASK ORDER 2**

Period of Performance:	January 1, 2015 through December 31, 2015
Solicitation No.:	NRC-HQ-12-C-04-0087, Task Order 2
Total Estimated Costs:	\$35,631.54
Offeror Name:	Energy Research, Inc.

#### Cost Details by Month:

Cost Elements	1st Month	2nd Month	3rd Month	4th Month	5th Month	6th Month
Direct Costs	\$1,659.30	\$1,659.30	\$1,659.30	\$1,659.30	\$1,659.30	\$1,659.30
Indirect Costs	\$1,310.00	\$1,310.00	\$1,310.00	\$1,310.00	\$1,310.00	\$1,310.00
Total Estimated Costs	\$2,969.30	\$2,969.30	\$2,969.30	\$2,969.30	\$2,969.30	\$2.969.30
Project Completion	8%	17%	25%	33%	42%	50%
Cost Elements	7th Month	8th Month	9th Month	10th Month	l l th Month	12th Month
Direct Costs	\$1,659.30	\$1,659.30	\$1,659.30	\$1,659.30	\$1,659.30	\$1,659.30
Indirect Costs	\$1,310.00	\$1,310.00	\$1,310.00	\$1,310.00	\$1,310.00	\$1,310.00
Total Estimated Costs	\$2,969.30	\$2,969.30	\$2,969.30	\$2,969.30	\$2,969.30	\$2,969.30
Project Completion	58%	67%	75%	83%	92%	100%

December 2012

NRC-HQ-12-C-04-0087, Task Order Number 2

#### Energy Research, Inc.

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#### **CONTRACTOR SPENDING PLAN – TASK ORDER 2**

Period of Performance:	January 1, 2016 through August 31, 2016
Solicitation No.:	NRC-HQ-12-C-04-0087, Task Order 2
Total Estimated Costs:	\$20,450.08
Offeror Name:	Energy Research, Inc.

Cost Details by Month:

Cost Elements	1st Month	2nd Month	3rd Month	4th Month	5th Month	6th Month
Direct Costs	\$1,429.09	\$1,429.09	\$1,429.09	\$1,429.09	\$1,429.09	\$1,429.09
Indirect Costs	\$1,127.17	\$1,127.17	\$1,127.17	\$1.127.17	\$1,127.17	\$1,127.17
Total Estimated Costs	\$2,556.26	\$2,556.26	\$2,556.26	\$2,556.26	\$2,556.26	\$2,556.26
Project Completion	13%	25%	38%	50%	63%	75%
Cost Elements	7th Month	8th Month	9th Month	10th Month	11th Month	12th Month
Direct Costs	\$1,429.09	\$1,429.09				
Indirect Costs	\$1,127.17	\$1,127.17				
Total Estimated Costs	\$2,556.26	\$2,556.26				
Project Completion	88%	100%				

December 2012

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