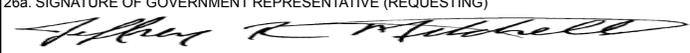


INTERAGENCY AGREEMENT		1. IAA NO. 31310018S0026			PAGE OF 1 2		
2. ORDER NO.		3. REQUISITION NO. RES-18-0372		4. SOLICITATION NO.			
5. EFFECTIVE DATE 09/18/2018		6. AWARD DATE 09/18/2018		7. PERIOD OF PERFORMANCE 10/01/2018 TO 09/30/2020			
8. SERVICING AGENCY GEOLOGICAL SURVEY UNITED STATES DEPARTMENT OF ALC: DUNS: 130047942 +4: 12201 SUNRISE VALLEY DR RESTON VA 201920002 POC [REDACTED] TELEPHONE NO. [REDACTED]				9. DELIVER TO US NUCLEAR REGULATORY COMMISSION ATTN [REDACTED] MAIL STOP [REDACTED] 11555 ROCKVILLE PIKE ROCKVILLE MD 20852			
10. REQUESTING AGENCY ACQUISITION MANAGEMENT DIVISION ALC: 31000001 DUNS: +4: US NUCLEAR REGULATORY COMMISSION ONE WHITE FLINT NORTH 11555 ROCKVILLE PIKE ROCKVILLE MD 20852-2738 POC Jeffrey R. Mitchell TELEPHONE NO. 301-751-8340				11. INVOICE OFFICE US NUCLEAR REGULATORY COMMISSION ONE WHITE FLINT NORTH 11555 ROCKVILLE PIKE MAILSTOP O3-E17A ROCKVILLE MD 20852-2738			
12. ISSUING OFFICE US NRC - HQ ACQUISITION MANAGEMENT DIVISION MAIL STOP TWFN-07B20M WASHINGTON DC 20555-0001				13. LEGISLATIVE AUTHORITY Economy Act			
				14. PROJECT ID			
				15. PROJECT TITLE A FRAMEWORK FOR TECHNICAL REVIEW OF PALEOFLOOD INF			
16. ACCOUNTING DATA 2018-X0200-FEEBASED-60-60D002-11-6-182-1014-251B							
17. ITEM NO.	18. SUPPLIES/SERVICES			19. QUANTITY	20. UNIT	21. UNIT PRICE	22. AMOUNT
	<p>Pursuant to the authority contained in the Economy Act, the U.S. Nuclear Regulatory Commission and the U.S. Geological Survey hereby enter into this Agreement, 31310018S0026, for the project entitled, "FRAMEWORK FOR TECHNICAL REVIEW OF PALEOFLOOD INFORMATION".</p> <p>The performance period for this agreement shall commence on October 1, 2018 and will expire on September 30, 2020.</p> <p>Consideration and Obligations: Continued ...</p>						
23. PAYMENT PROVISIONS				24. TOTAL AMOUNT \$100,000.00			
25a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (SERVICING)				26a. SIGNATURE OF GOVERNMENT REPRESENTATIVE (REQUESTING) 			
25b. NAME AND TITLE		25c. DATE		26b. CONTRACTING OFFICER JEFFREY R. MITCHELL		26c. DATE 09/24/2018	

(a) Authorized Cost Ceiling \$197,872.40

(b) The amount presently obligated with respect to this Agreement is \$100,000.00. When and if the amount(s) paid and payable to the servicing agency hereunder shall equal the obligated amount, the servicing agency shall not be obligated to continue performance of the work unless and until the NRC Contracting Officer shall increase the amount obligated with respect to this Agreement. Any work undertaken by the servicing agency in excess of the obligated amount specified above is done so at the servicing agency sole risk.

The following documents are hereby made part of this Agreement:

- Attachment No. 1: Statement of Work
- Attachment No. 2: IAA Standard Terms and Conditions

NRC CONTRACTING OFFICERS REPRESENTATIVE (COR):
[REDACTED] (Primary) [REDACTED] (Alternate)

USGS PROJECT MANAGER: [REDACTED]
Master IAA: N/A

00001

Authorized Cost Ceiling
Total Obligated Amount: \$197,872.40
Incrementally Funded Amount: \$100,000.00

ALC: 31000001
DUNS: 040535809
TAS: 31X0200.320

- Fee Recoverable Work
- Non-fee Recoverable Work

The total amount of award: \$197,872.40. The obligation for this award is shown in box 24.

197,872.40

STATEMENT OF WORK

NRC Agreement Number 31310018S0026	NRC Agreement Modification Number	NRC Task Order Number (If Applicable)	NRC Task Order Modification Number (If Applicable)
Project Title Framework for Technical Review of Paleoflood Information			
Common Cost Center Code	B&R Number	Servicing Agency U.S. Geological Survey	
Principal Investigator : <ul style="list-style-type: none"> - Name [REDACTED] - Address 12201 Sunrise Valley Drive MS 415 Reston , VA 20192 - Phone [REDACTED] - [REDACTED] 			
NRC Requisitioning Office Office of Research			
NRC Form 187, Contract Security and Classification Requirements <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> Not Applicable		<input type="checkbox"/> Involves Proprietary Information <input type="checkbox"/> Involves Sensitive Unclassified	
<input checked="" type="checkbox"/> Non Fee-Recoverable		<input type="checkbox"/> Fee-Recoverable (If checked, complete all applicable sections below)	
Docket Number (If Fee-Recoverable/Applicable)		Inspection Report Number (If Fee Recoverable/Applicable)	
Technical Assignment Control Number (If Fee-Recoverable/Applicable)		Technical Assignment Control Number Description (If Fee-Recoverable/Applicable)	

1 - BACKGROUND

Regulatory Context:

The U.S. Nuclear Regulatory Commission (NRC) has developed regulations regarding the siting and design of nuclear power plants (NPPs) aimed at providing safety from various natural hazards, including flooding. Design criteria for nuclear power plants with respect to natural hazards are provided in the appropriate sections of 10 CFR Part 50, and Part 52. IOCFR Part 100 addresses siting criteria.

The regulatory criterion for protection of structures, systems, and components (SSCs) important to safety against natural phenomena is provided in 10 CFR Part 50 Appendix A, General Design Criterion (GDC) 2 "Design bases for protection against natural phenomena". GDC-2 states that SSCs important to safety shall be designed to withstand the effects of natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated. The regulation also states that the design bases shall reflect appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena.

The requirements for the contents of applications for new reactors is provided in 10 CFR Part 52, more specifically 10 CFR Part 52.17(a)(1)(vi), for early site permits (ESPs) and 10 CFR Part 52.79 (a)(1)(iii), for combined licenses as they relate to the hydrologic characteristics of the proposed site with appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

Reactor site criteria are provided in 10 CFR Part 100. The requirements to consider physical site characteristics (including hydrologic features) in site evaluations are specified in 10 CFR Part 100.10(c) for applications before January 10, 1997, and 10 CFR Part 100.20(c) for applications on or after January 10, 1997.

NRC regulatory guidance for flood hazard assessments currently focuses on using deterministically derived, conservative estimates of key flood causing mechanisms (e.g. Probable Maximum Precipitation, Probable Maximum Flood) to provide the "sufficient margin" called for in the regulations. The magnitude of the provided margin is not explicitly quantified in either a physical or risk sense.

Probabilistic treatment of flood hazard phenomena can provide quantitative estimates of the flood safety margin and thus contribute to the risk-informed assessment of flooding hazards, but regulatory guidance on the use of probabilistic methods for riverine flood hazard assessment at nuclear power plant sites is lacking.

This research project is part of the NRC's Probabilistic Flood Hazard Assessment (PFHA) Research plan. The proposed work will aid development of guidance on the use of PFHA methods and support risk-informing NRC's licensing framework (flood hazard design standards at proposed new facilities as well as significance determination tools for evaluating potential deficiencies related to flood protection at operating facilities). The tools and guidance developed will support and enhance NRC's capacity to perform thorough and efficient reviews of license applications and

license amendment requests. They will also support risk-informed significance determination of inspection findings, unusual events and other oversight activities.

Technical Context:

Hydrological processes such as riverine flooding exhibit substantial variability that cannot be adequately described by deterministic application of physical laws. Uncertainty in modeling riverine flooding processes arises from: 1) inherent randomness in drivers such as rainfall and physical features of the watershed; 2) sampling errors; and 3) incomplete understanding of the hydrologic processes involved. Therefore statistical and probabilistic modeling approaches are often used, in combination with process-based understanding, to develop insights into the expected magnitude and variability of future observations and to estimate design floods.

Flood frequency analysis is a statistical method used to estimate design floods for sites along a river that uses observed peak flow discharge data (usually annual maximums) to calculate statistical information such as mean values, standard deviations, skewness, and recurrence intervals. These statistical data are then used to construct frequency distributions, which are curves that estimate the likelihood of various discharges as a function of average recurrence interval (in years) or annual exceedance probability (i.e., the probabilities of floods of various sizes can be extracted from the curve). Where long historical flow records are available at a site, the flood frequency curve can be estimated using flood peak data from the site alone.

A plethora of distribution functions and estimation methods are available for developing flood frequency curves (Kite 1977, Stedinger, Vogel et al. 1993). This situation prompted the Hydrology Subcommittee of the Interagency Advisory Committee on Water Data (IACWD) to develop Bulletin 17B, "Guidelines for Determining Flood Flow Frequency" (B17B, IACWD 1982), in order to promote a consistent approach to flood-flow frequency determination among federal, state, and local agencies.

IACWD was superseded by the Interagency Advisory Committee on Water Information (ACWI) in 1996. Recently, the ACWI Subcommittee on Hydrology (ACWI/SOH) chartered the Hydrologic Frequency Analysis Work Group (HFAWG) to update the guidelines and draft an updated document (Bulletin 17C, or B17C). Though Bulletin 17C explicitly details a method for using paleo-flood hydrology data, there is a lack of guidance on technical review of paleo-flood study results for extrapolation of derived flood frequency curves for nuclear power plant licensing and oversight applications.

Paleoflood hydrology studies are an increasingly important tool for extending the effective flood record and thus informing estimates of the magnitude and frequency of flooding hazards used for design of critical infrastructure such as nuclear power plants. However, standards of practice for conducting and reviewing such studies are lacking, which inhibits their effective use in regulatory decisionmaking.

This project will provide a framework and technical review framework for NRC staff on standards of practice methods for conducting and reviewing paleo-flood studies and the application of such methods to flood frequency analysis used in nuclear power plant licensing and oversight.

2. OBJECTIVE

The objective of this Agreement is for U.S. Geological Survey (USGS) to develop a Framework for Technical Review of state-of-the-practice paleoflood study results for use in flood frequency methods and tools. The Framework will be a logically structured method describe in a technical report that describes and provides guidance for the state of practice for different methods and techniques of preparation for, gathering, evaluation and interpretation of paleoflood information, as detailed below in the scope of work. The Framework will be an evaluation of the state of practice for the most commonly used methods and provide guidance for assessing if best practices are in use and uncertainties at multiple levels of paleoflood study effort. The Framework will provide enough detail to assess the quality of the methods determined in the preliminary survey to be sufficiently robust to support a technical review. The information and conclusions within the Framework will be supported using the experience of literature and subject matter expertise gathered through review, engagement of experts, and a public workshop.

3. SCOPE OF WORK

The following list provides the general scope of work (SOW) under this project. To accomplish the objectives of this project the USGS will:

1. Develop an outline of the details that will be assessed and incorporated into the Technical Review Framework of paleoflood information based on a preliminary survey of the field.
2. Develop a draft Technical Review Framework which details best practices and approaches for use of the elements at the level of detail described in the Task 1 outline.
3. Plan and conduct a public workshop to collect perspectives and recommendations from a broad range of subject matter experts on the technical review framework.
4. Prepare an integrated report describing a final technical review framework for paleoflood projects based on the draft framework and workshop insights.

With the exception of providing the venue for the training seminar listed in item 4 above, USGS must provide all resources necessary to accomplish the tasks and deliverables described in this SOW.

4. SPECIFIC TASKS

The following section describes the specific tasks under this task order. To accomplish the objectives of this project the USGS shall:

Task 1: Conduct a Preliminary Survey of the Field and Prepare Draft Outline of Technical Review Framework

The USGS will conduct a preliminary survey of the field (e.g. study types, scopes, purposes, key information collected, key areas of professional judgement) in order to develop an outline of the Technical Review Framework to be developed in task 2. The Draft Outline will include a description of the levels of review to be included and the detail to which specific methods and approaches for review of paleoflood information are supported by literature and the state of practice.

The USGS will describe in the Draft Outline two or more distinct levels of review effort that will be used in the Technical Review Framework to be developed in task 2. These review levels should be commensurate with the scope, complexity, and ultimate use of the paleoflood study (e.g. simple or low risk, complex or high risk and critical decision). For some level(s), the technical review may include a formal peer review (e.g. USGS, EPA, NPS, NRC guidelines).

The USGS will also describe in the Draft Outline the extent to which the elements and approaches for conducting the methods below will be evaluated in the Technical Review Framework to be developed in task 2. The extent of details that will be focused on for each item should be supported in the literature and state of practice. The outline will include an estimate (e.g. in time spent, expected pages, or other.) of the critical review and framework detail that is justified by the state of practice in the Technical Review Framework in task 2. The elements and approaches to be preliminarily surveyed and described in the Draft Outline are:

- a) Site selection (e.g., field reconnaissance, analysis of floodplain stratigraphy)
- b) Identification, sampling, and analysis/interpretation of paleostage estimates and bounds (e.g., slackwater deposits)
- c) Identification, sampling, and analysis/interpretation of hydroclimate information (e.g. tree rings)
- d) Methods for reconstructing flood discharges from paleostage information (e.g. hydraulic modeling)
- e) Paleocompetence studies (e.g. tractive boulders)
- f) Techniques for estimating absolute or relative ages of floods ages (e.g., stratigraphy, geochronology)
- g) Statistical methods for incorporating paleoflood information in flood-frequency analyses (e.g., data structuring, censoring, distribution selection, quantile estimation)

The Draft Outline of the Technical Review Framework will be submitted as a letter report addressing and supporting the detail in the Technical Review Framework for each of the areas described above. This outline will be presented in a webinar and as a written report.

Deliverable: Draft Outline Webinar and Letter Report

Task 2: Draft Technical Review Framework

Upon approval of the Draft Outline developed in Task 1, USGS will provide a Framework for Technical Review for assessing paleoflood information gathered and evaluated in support of flood hazard analysis. Using surveys of the available literature, professional experience of USGS staff, as well as professional experience of the wider technical community (e.g. federal, state and local agency staff, private consultants, academicians), the USGS will provide detailed support for review of techniques and methods for conduct of paleoflood information gathering studies and practices, including site selection, sampling, analysis, and interpretation of results. The robustness of results (e.g., maturity of methods, multiple lines of evidence, correlation between sites, uncertainty analysis) and the impact of each of the methods on incorporating paleoflood information in flood

frequency or probabilistic flood hazard analysis shall be described.

The Framework will include best practice descriptions at least two levels of review effort for the items as detailed in the Draft Outline. The Framework will contain sufficient information for independent review of paleoflood studies, but may reference basic sources to support technical details of paleoflood sciences.

Deliverable: Draft Report of Framework for Technical Review of Paleoflood Information

Task 3: Public Workshop

USGS will conduct a public workshop to collect perspectives and recommendations from a broad range of subject matter experts (e.g. federal, state and local agency staff, private consultants, academicians) and stakeholders. Specifically, the USGS will

- a) Develop a workshop agenda and select invited workshop panelists to meet and discuss the elements of a Technical Review framework. This task includes travel cost for up to 4 USGS staff members and may provide travel funds for up to 3-4 key individuals (mainly academics) whose participation is highly desirable to ensure a successful workshop. USGS will announce the workshop to the experts in the field, invite attendees, develop topics determined from task 1 and 2 that call for further discussion, and to organize sessions and/or panels. USGS will provide a participant information list to NRC for their records and entry purposes.
- b) Develop and distribute to attendees and NRC staff workshop materials which include, at a minimum, an agenda, and may include: (a) summarized information collected during the preliminary survey; (b) draft review framework; and (c) questions or surveys for panelists and/or attendees to complete before, during, or after the workshop regarding their experience and interpretations of the workshop topics.
- c) Conduct a public workshop (minimum one-day) at NRC HQ in Rockville, MD. NRC will provide the public notice for the workshop, a conference room with projection and telephone capabilities and arrange access for the registered participants with security staff. USGS will run the workshop technical content (i.e. the agenda, topics, panels), including moderation, organizing panel or discussion group chairs and materials. At the request of USGS, an alternative location for the workshop may be authorized by the NRC.
- d) Document the workshop in the form of a letter report.

Deliverable: Workshop Agenda, Participant Information List, Delivery of Workshop, Documentation of Workshop Letter Report.

Task 4: Integrate Results

Integrate the, draft framework and workshop results into a revised Framework for Technical Review of paleoflood studies.

Deliverables: Final Report Technical Review Framework.

5. DELIVERABLES SCHEDULE

The main project deliverables will be monthly letter status reports (MLSRs) and a final integrated report describe in Task 4. NRC will review and provide comments on the draft report to the USGS.

Task Number	Deliverable/Milestone Description	Due Date
1	USGS shall provide a Draft Outline of the Framework for Technical Review of Paleoflood Information	NLT 6 months from the commencement of this agreement
2	USGS shall provide a draft Framework for Technical Review of Paleoflood Information as described in the Task 1 Draft Outline	NLT than 6 months from the NRC acceptance of the Task 1 Outline
3	USGS shall provide a draft agenda for the public workshop	NLT than 30 days before the workshop
	USGS shall provide a registrant list for the public workshop	NLT than 3 working days before the workshop. (2 weeks for international registrants)
	Upon approval of the agenda and invited attendees, USGS shall deliver a workshop to review the Framework as described in Task 3	NLT 90 days before the end of the POP
	USGS shall provide a letter report documenting the workshop	30 days after workshop
4	USGS shall provide a Draft Final Report of the Framework for Technical Review of Paleoflood Information	NLT 60 days before the end of the POP
4	USGS shall provide a final report in response to NRC comments on the draft report.	30 days after comments received
	USGS shall submit a Monthly Letter Status Report	NLT 20th of each month

6. TECHNICAL AND OTHER SPECIAL QUALIFICATIONS REQUIRED

The work to be performed in this project requires significant expertise and experience in the following areas: 1) paleo-flood hydrology, 2) probability and statistical theory, and 3) probabilistic and statistical analysis of stream flows. Experience in flood frequency analysis including use of paleoflood data is required. USGS shall demonstrate that their staff has the technical ability to perform the tasks outlined in this SOW. Generally, this ability would be a doctorate or equivalent in a relevant science or engineering discipline (e.g., hydrology, water resources engineering). A demonstration of any combination of equivalent experience and/or education in the previously mentioned disciplines may be considered as meeting the technical qualifications.

7. MEETINGS AND TRAVEL

The Principal Investigator (PI) shall make (up to two) four-day trips to meet with NRC staff at an Annual Workshop at NRC Headquarters in Rockville, MD.

Workshop travel will be provided under this agreement by the USGS for up to 4 USGS staff members and up to 4 invited attendees.

All travel requires written Government approval from the Contracting Officer's Representative. No foreign travel is authorized under this Agreement.

9. REPORTING REQUIREMENTS

Monthly Letter Status Report

A Monthly Letter Status Report (MLSR) shall be submitted to the NRC Contracting Officer Representative by the 20th of the month following the month to be reported with copies to the Contracting Officer (CO) and the Office of Administration Acquisition Management Division to ContractsPOT.Resource@nrc.gov. If a project is a task ordering agreement, a separate status report must be submitted for each task order with a summary project status report, even if no work has been performed during a reporting period.

Once NRC has determined that all work on a task order is completed and that final costs are acceptable, a task order may be omitted from the MLSR.

The servicing agency is responsible for structuring the deliverable to follow agency standards. The current agency standard is Microsoft Office Suite 2010. The current agency Portable Document Format (PDF) standard is Adobe Acrobat 9 Professional. Deliverables must be submitted free of spelling and grammatical errors and conform to requirements stated in this section.

10. PERIOD OF PERFORMANCE

The period of performance for this work is October 1, 2018 through September 30, 2020.

11. CONTRACTING OFFICER'S REPRESENTATIVE

The COR monitors all technical aspects of the agreement/task order and assists in its administration. The COR is authorized to perform the following functions: assure that the servicing agency performs the technical requirements of the agreement/task order; perform inspections necessary in connection with agreement/task order performance; maintain written and oral communications with the servicing agency concerning technical aspects of the agreement/task order; issue written interpretations of technical requirements, including Government drawings, designs, specifications; monitor the servicing agency's performance and notify the servicing agency of any deficiencies; coordinate availability of NRC- furnished material and/or GFP; and provide site entry of servicing agency personnel.

Contracting Officer's Representative

Name: [REDACTED]

Agency: U.S. Nuclear Regulatory Commission

[REDACTED]
[REDACTED]
[REDACTED]

Alternate Contracting Officer's Representative

Name: [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

12. MATERIALS REQUIRED

Not Applicable.

13. NRC-FURNISHED PROPERTY/MATERIALS

Not Applicable.

14. OTHER CONSIDERATIONS

Not Applicable.

15. REFERENCES

National Park Service (NPS), U.S. Department of the Interior, Interim Guidance Document Governing Code of Conduct, Peer Review, and Information Quality Correction for National Park Service Cultural and Natural Resource Disciplines. Accessed at <https://www.nps.gov/policy/Interimpeerreview.htm>

Nuclear Regulatory Commission (NRC). Applying OMB Peer Review Guidelines, Sections B & C. Accessed at <https://www.nrc.gov/public-involve/ml051600303.pdf>

U.S. Environmental Protection Agency (EPA) Peer Review Handbook, 4th edition, October 2015. Accessed at https://www.epa.gov/sites/production/files/2016-03/documents/epa_peer_review_handbook_4th_edition.pdf