

Critical & Subcritical Experiment Design Team of the US DOE Nuclear Criticality Safety Program

A. Nichole Ellis & James R. Felty

ICNC 2011: The International
Conference on Nuclear Criticality

19th – 22nd September 2011
Edinburgh, Scotland



The NCSP Mission & Vision

The Mission and Vision

of the
United States Department of Energy
Nuclear Criticality Safety Program

for the
Fiscal Years
2009-2018



Integral Experiments Vision

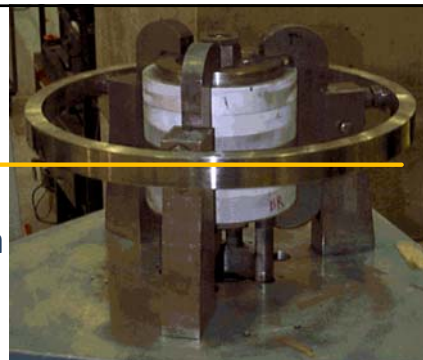
- The IE element will provide a **sustainable** infrastructure and a systematic, interactive process to assess, design, perform, and document integral criticality safety-related benchmark-quality experiments to support **safe, efficient** fissionable material **operations**.



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History

- In the past, almost all national laboratories had a Critical Experiment Facility
- In recent years, the DOE previously performed the majority of critical, subcritical, and fundamental physics measurements at the Los Alamos National Laboratory in Los Alamos, New Mexico
- Sandia National Laboratory has been a continual operating facility available for experiments



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History (cont'd)

- DOE shut down the experiment operations at Los Alamos and safely transported the material and associated equipment to a new, more secure location at the Nevada National



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Security Site (formerly Nevada Test Site)

- Additionally, no real process in place to ensure all data from measurements was captured

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Integral Experiment Goals

- General purpose fast-burst and dry system criticality experiments and training facility at the National Criticality Experiments Research Center (NCERC) located at the Device Assembly Facility (DAF) in Nevada
- General purpose water moderated criticality experiments and training facility at SNL
- General purpose actinide solution super-prompt critical assembly and large horizontal split-table capability at Valduc, France
- Supports new reactor and fuel cycle designs, waste disposal, criticality accident detection and response, military applications, and nuclear counter-terrorism applications
- Fully integrated program with integral experiments, state of the art sensitivity/uncertainty analysis, nuclear data processing, and benchmark analysis

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Current Status

- The new National Criticality Experiments Research Center (NCERC) is currently in Start-up at the Device Assembly Facility
- It has already resumed subcritical and fundamental physics measurements and had the first Critical Experiments with PLANET & COMET
- NCERC started a pilot hands-on training course in 2011
- Sandia National Laboratory currently available, will continue to perform water moderated criticality experiments and start training for unclassified personnel



Current Status (cont'd)

- Additionally, the US DOE has contracts in place with the French government for joint measurements/data acquisition
- VNIITF, Russia continues to perform experiments for US requested data needs
- The C_EdT Process was developed to provide the systematic, interactive process to assess, design, perform, and document integral criticality safety-related benchmark-quality experiments

Critical Subcritical Experiment Design Team (C_EdT) Process

- Ensure requestor's nuclear data needs are well understood and met by integrating all capabilities of the NCSP to design and approve the requested measurements, including deciding which facilities within the DOE are best suited to perform and document the requested measurements.



Goals of Process

- Identifies the nuclear data needs precisely
- Assesses the available experimental materials and all facility capabilities for the data need
- Uses Tsunami/sensitivity tools to design the experiment
- Ensures quality evaluation and documentation of the experiment (i.e., ICSBEP Publication)
- Ensures quality/precision of the experiment in design and execution (QA/QC)
- Establishes an ongoing transparent process
- Federal NCSP operations authorization of integral experiments



Overview of Process

- In order to meet its goals for each new integral experiment, the C_EdT process is divided into five steps called Critical/Subcritical Experiment Decision (CED) steps. The NCSP Manager approves each CED to ensure that the Requestor's needs and the NCSP programmatic needs are being met. The C_EdT steps consist of:
 - CED-0: Justification of Integral Experiment Need
 - CED-1: Integral Experiment Preliminary Design (Form the C_EDT)
 - CED-2: Integral Experiment Final Design,
 - CED-3: Approval to Conduct the Integral Experiment
 - CED-3a: Initiate Facility Plan/Cost Estimate
 - CED-3b: Approve Execution as Part of NCSP Five-Year Plan Process
 - CED-4: Publication of Data
 - CED-4a: Analysis of the Data for Publication
 - CED-4b: Final Approved Publication of Data



Overview of Process (Cont'd)

- The C_EdT will consist of, at a minimum:
 - Customer/Requestor,
 - Nuclear Data Advisory Group (NDAG) Member,
 - Publication or International Criticality Safety Benchmark Experiment Project (ICSBEP) Member,
 - Analytical Methods Member, and
 - C_EdT Lead (experimental facility member).
- This team will work with the User to ensure all elements of the program for subcritical and critical experiments are met.

Online C_EdT Process

- Website is used to submit all requests at:
<http://ncsc.llnl.gov/>
- Website is set up to maintain a history of the request with all actions noted
- All experiment documentation is uploaded onto the website
- All approvals are done on the website
- Manual available with instructions for all users of the website



**U. S. Department of Energy
Nuclear Criticality Safety Program**


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The purpose of this webpage is to provide a mechanism for End Users to submit proposed Critical and Subcritical Integral Experiments Requests for consideration/processing. An explanation of the process and association links (including the Integral Experiments Request form) are also provided. If you have any questions regarding the process, please contact the CE_dT Manager, [Nichole Ellis at ellis_9899@msn.com](mailto:Nichole.Ellis@llnl.gov) or 803-381-3710

- [Submit Integral Experiment Request](#)
- [Critical & Subcritical Experiment Design Team Process Manual](#)


C_EdT Status & Administration


- [Approved Experiments C_EdT Members and Current Status](#)
- [C_EdT Members General Access Only](#)
- [C_EdT Members Limited Access Only](#)
- [C_EdT Deputy Manager Access Only](#)
- [NDAG Approval \(NDAG Reviewer Only\)](#)
- [NCSP Manager Approval \(DOE HQ Only\)](#)



CED-0: Justification of Integral Experiment Need

- Statement of need (should include detailed process description of the data application for understanding of the need) - Should include benefits/justification and when data needed
- User assessment of available integral data, citing specific references used to investigate data need
- Proposed conceptual integral experiment suggested




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REQUEST FOR INTEGRAL EXPERIMENTS FORM

NOTICE: The End User must verify all information is **UNCLASSIFIED**

Please provide the following information:

Form Status: Working draft

Requestor Name:

Last Name: [*] <input style="width: 90%;" type="text"/>	First Name: [*] <input style="width: 90%;" type="text"/>	Middle Name: <input style="width: 90%;" type="text"/>
Affiliation: [*] <input style="width: 100%;" type="text"/>		
E-mail Address: [*] <input style="width: 100%;" type="text"/>		
Retype E-mail Address: [*] <input style="width: 100%;" type="text"/>		
Telephone No.: [*] <input style="width: 100%;" type="text"/>		

[*] Required fields

Experimental Request Title: [*]

Description of Application/Purpose (same level of detail as in DOE-STD-3007-2007); 6000 chars max

Select Those That Apply and Explain:

Programmatic Funding Available (optional):

User Assessment of Available Integral Data (ICSBEP, Published, UnPublished, etc.); 6000 chars max

Suggested Experiment Concept (optional); 6000 chars max

C&DT Manager Comments; 6000 chars max


NDAG Chairperson Comments; 6000 chars max

ICSP Manager Comments; 6000 chars max

Approval Section Here

The Requestor acknowledges all information is approved for public release. [*] ☐ I Agree

DC Name or Review and Release Number:


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CED-0: Justification of Integral Experiment Need (cont'd)

- Once submitted and reviewed, submitted to NDAG who, as necessary, works with an ICSBEP member, Analytical Member and/or the C_EdT Lead to determine if there is a valid need for the requested data, if there are already data available within the NCSP to satisfy the need, or if the data request is not a valid or viable need.
- Request returned to Requestor or approved by NCSP Manager.

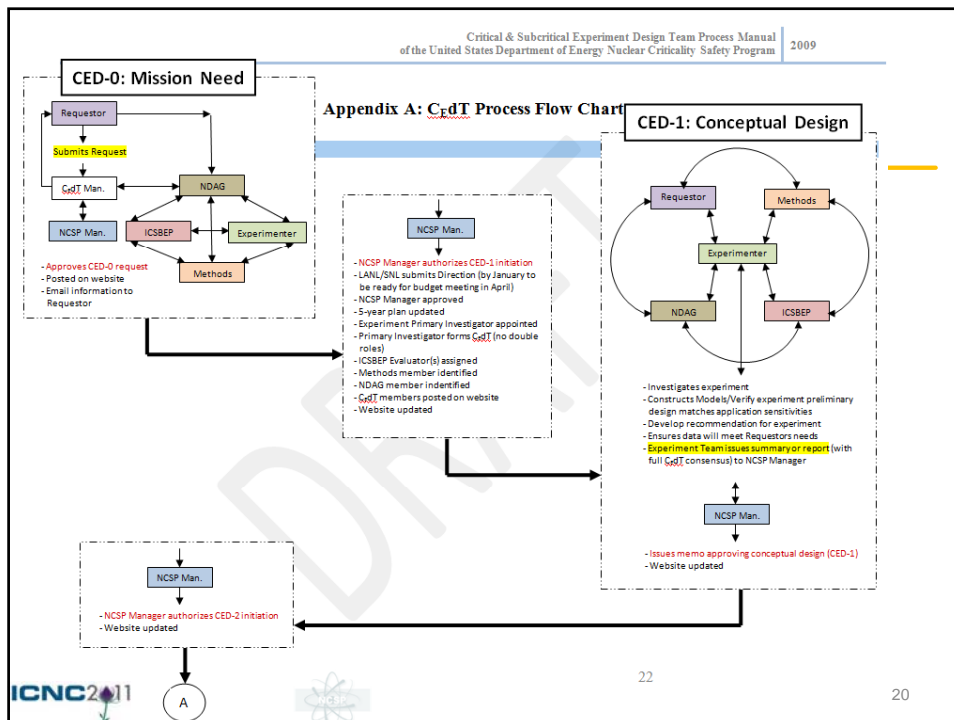


CED-1: Integral Experiment Preliminary Design

- Final team members of C_EdT assigned by Lead
- CED-1 authorized to start based on current funding levels, NCSP priorities, schedule of the Requestor's need, facility availability, material availability, etc.
- Design begins with discussion of the objectives of the experiment and possible approaches to meet the objectives.
- Discussion results in a determination of the proper facility, machine, equipment and materials necessary to satisfy the Requestor's data needs.

CED-1: Integral Experiment Preliminary Design (cont'd)

- C_{EDT} downs-selected to a specific preliminary experiment design, work continues on analyses, discussion and reporting of the experiment exactly as if it were to be the final experiment design
- The Requestor's data needs may include one or more measurements of one or more types of experiments:
 - K_{eff} (Critical, Sub-Critical Configurations)
 - Deep Transport (Shielding, CAAS, etc.)
 - Reaction Rates (Spectral Indices, Spatial Profiles, Dosimetry, etc.)
 - Spectrum (Neutron, Gamma)
 - Reactivity Worths (Small-sample, Control Rods, Material Replacement, Doppler Temperature Coefficients, Void or Insertion)
 - Kinetic Parameters (β_{eff} , Delayed Neutron Fractions, a_i 's and λ_i 's, etc.)
- NCSP Manager reviews CED-1 package for approval

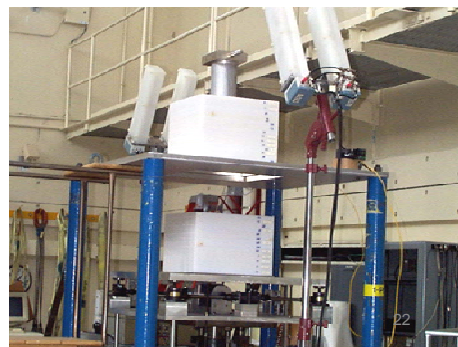


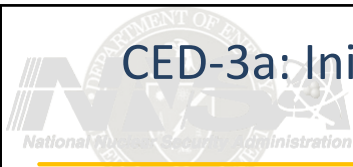
CED-2: Integral Experiment Final Design

- NCSP Manager decides appropriate time for CED-2 initiation.
- C_EdT determines what, if any, changes may be required in the preliminary design to define the final experiment plan:
 - C_EdT Lead finalizes the design and tolerances of experiment components
 - Methods member makes any revisions necessary in the representation of the final experiment design and re-calculates the reported (predicted) values
 - the Publication/ICSBEP member utilizes the design and tolerances of components provided by the C_EdT Lead to quantify all components of the experiment uncertainty
 - C_EdT reviews all values of the final design for inclusion in the final experiment plan, including any major possible uncertainties

CED-2: Integral Experiment Final Design (cont'd)

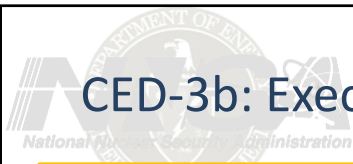
- Team documents design in a summary/report that includes all relevant data generated during the development phase (e.g., draft evaluations, input files, memos, etc.)
- The NCSP Manager reviews the final design package for CED-2 for approval





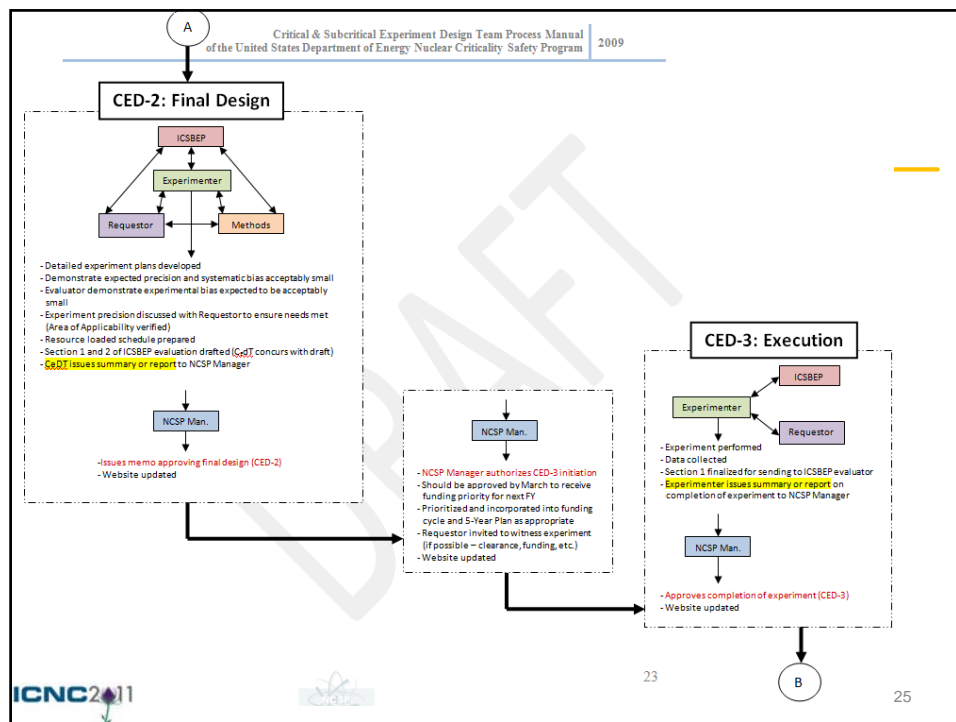
CED-3a: Initiate Facility Plan/Cost Estimate

- NCSP Manager decides appropriate time for CED-3 initiation.
- C_EdT Lead prepares:
 - facility experiment plan or similar documentation
 - a resource loaded (baseline) schedule for execution of the experiment, data analysis, and publication based on the priority of the experiment requestor's data need
 - a detailed cost estimate for the experiment fabrication, execution, data analysis, and facility publication
- The NCSP Manager reviews the documentation, iterates with the C_EdT Lead if necessary, and approves CED-3b, Execution of the Experiment.



CED-3b: Execution of the Experiment

- NCSP Manager approves CED-3 initiation.
- Experiment is performed (C_EdT Lead works with the Requestor and Publication Member to ensure experiment does not deviate from the intended purpose and all relevant data are appropriately recorded for evaluation)
- After completion and documentation of the experiment, C_EdT Lead develops a summary or report that includes all relevant data generated during the experiment (e.g., final draft evaluation Section 1 for ICSBEP, logbook records, input files, memos, etc.).
- The NCSP Manager reviews the package for CED-3 for approval.

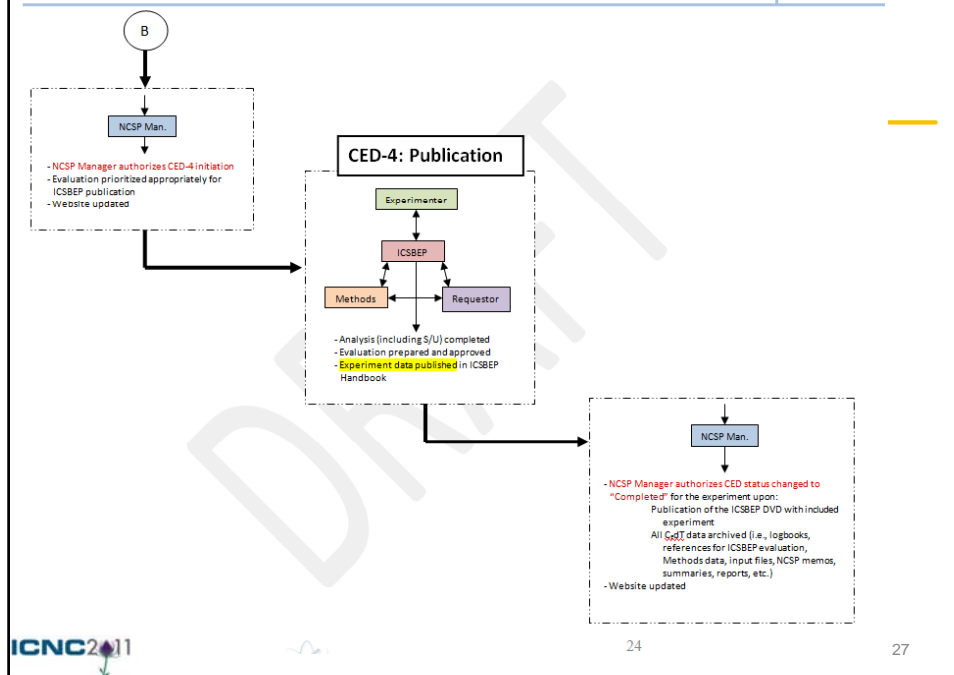


CED-4a & 4b: Publication of Data

- When the experiment is completed, the experiment is evaluated and documented per the appropriate guidelines for the type of measurement performed
- The documented evaluation is reviewed for approval by the ICSBEP or responsible facility per established guidelines for the type of measurement and the publication requirements and published appropriately
- Upon satisfactory review of the C_{EDT} Process for the experiment and publication of the experiment, (e.g., in the ICSBEP Handbook) the NCSF Manager approves CED-4, thereby completing the Integral Experiment Request.

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Current Status of Proposed Experiments

- 8 Subcritical NCERC exp. requests approved/7 awaiting approval
- 1 VNIITF critical exp. in progress/1 awaiting approval
- 1 SILENE critical exp. in progress
- 1 VALDUC critical experiment series in evaluation stage
- 2 Sandia critical experiment in progress/1 starting this FY
- >20 Critical NCERC experiment requests approved/>20 awaiting approval (criticality safety, stockpile science experiments, NCT experiment, Naval Nuc program, etc.)





Questions?