

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

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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.



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

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 Security Site (formerly Nevada Test Site)
- Additionally, no real process in place to ensure all data from measurements was captured



Integral Experiment Goals

- General purpose fast-burst and dry system criticality experiments and training facility at Criticality Experiments Facility (CEF) 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



Current Status

- The new Critical Experiment Facility (CEF) is currently in Start-up at the Device Assembly Facility
- It has already resumed subcritical and fundamental physics measurements and had the first Critical Experiment two weeks ago with PLANET
- CEF will start a pilot hands-on training course in August 2011
- Sandia National Laboratory currently available, will continue to perform water moderated criticality experiments and start training for uncleared 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



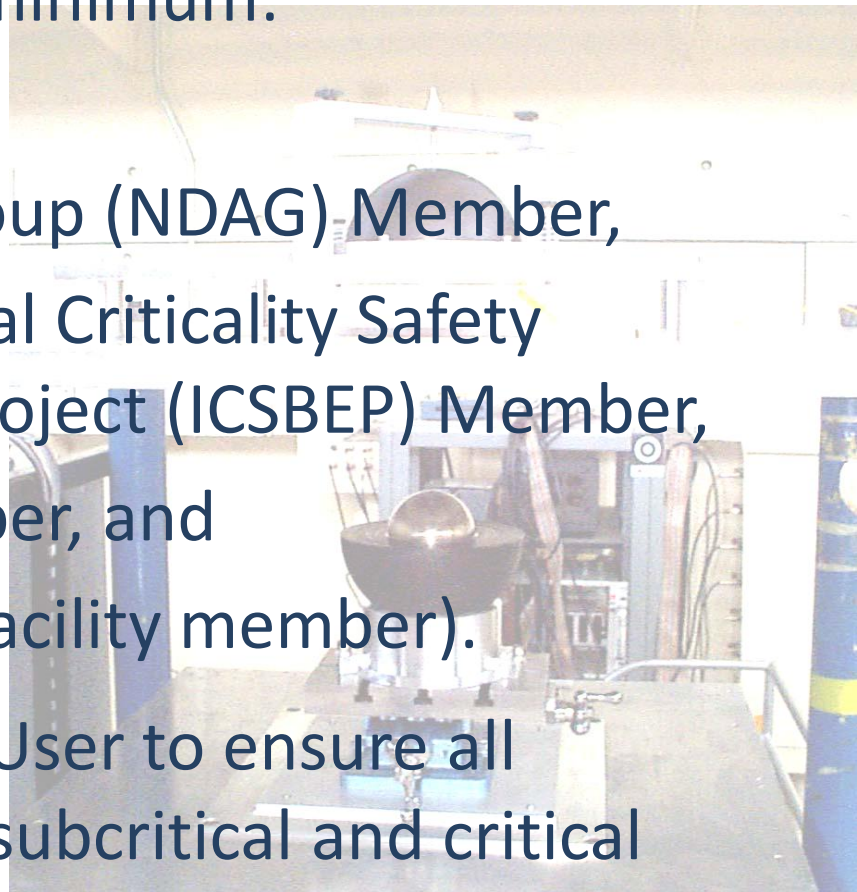
Overview of Process

- 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 $C_E dT$ 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
 - $C_E dT$ 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





Handling of Limited/Classified Proposals/Analysis

- Must contact the NCSP Manager directly for classified requests currently
- Only title documented on public site
- Basic information currently tracked in Limited area of Website
- Classified website in development
- Classified ICSBEP process also in development





U. S. Department of Energy Nuclear Criticality Safety Program

[NCSP Home Page](#)

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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_EdT Manager, [Nichole Ellis at ellis.9899@msn.com](mailto:Nichole.Ellis@ellis.9899@msn.com) or 803-381-3710

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

CE_EdT Status & Administration

- [Approved Experiments CE_EdT Members and Current Status](#)
- [CE_EdT Members General Access Only](#)
- [CE_EdT Members Limited Access Only](#)
- [CE_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

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: [*]

First Name: [*]

Middle Name:

Affiliation:[*]

E-mail Address: [*]

Retype E-mail Address: [*]

Telephone No.: [*]

[*] 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_EdT Manager Comments:[6000 chars max]

NDAG Chairperson Comments:[6000 chars max]

NCSP 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:

Submit

Reset



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.

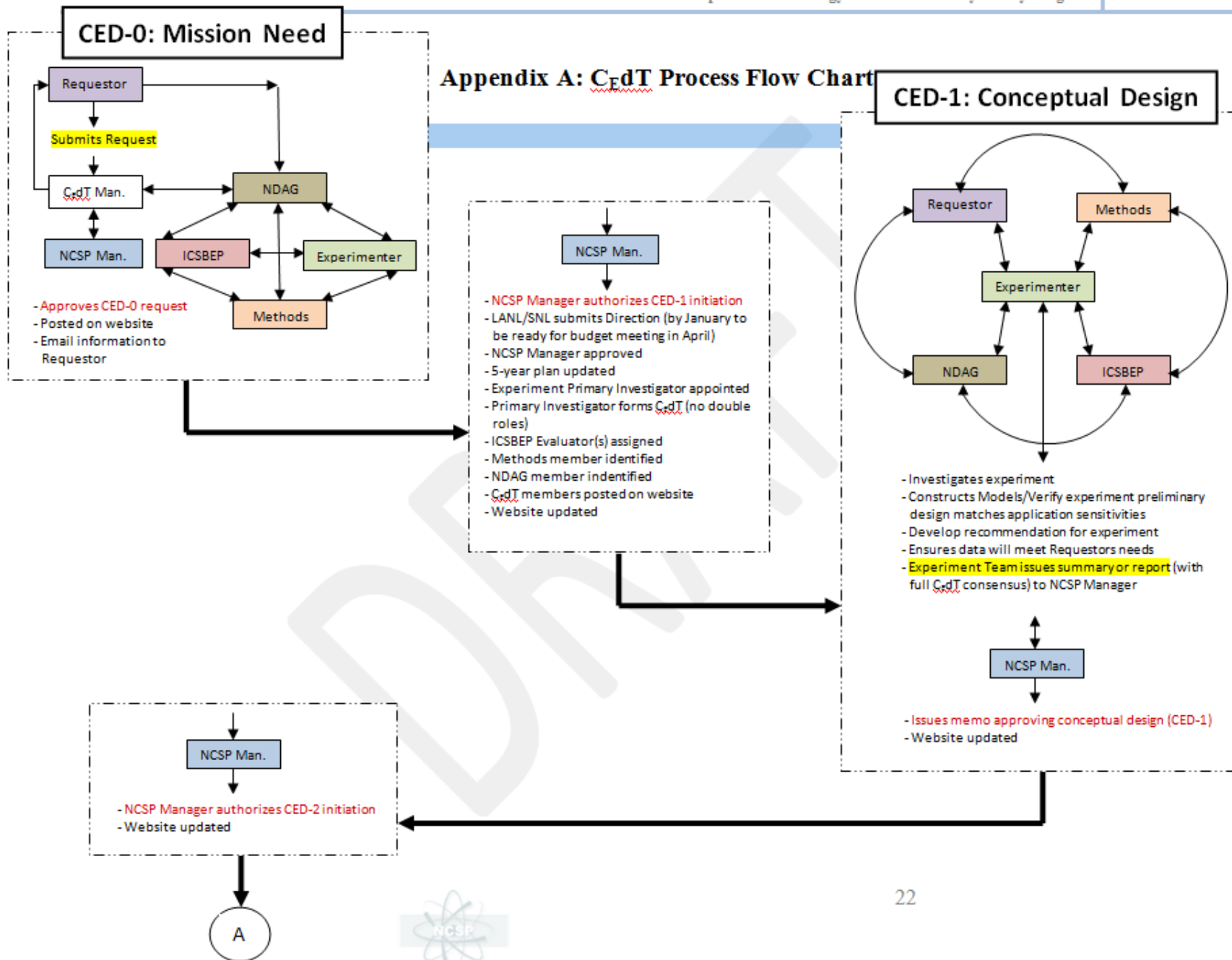


CED-1: Integral Experiment Preliminary Design (cont'd)

- C_E dT down-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



Appendix A: C_{ED}T Process Flow Chart





CED-2: Integral Experiment Final Design

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

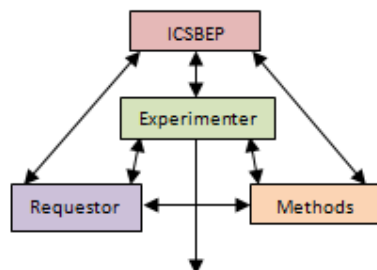


CED-3b: Execution of the Experiment

- NCSP Manager approves CED-3 initiation.
- Experiment is performed (C_E dT 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_E dT 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.

A

CED-2: Final Design



- Detailed experiment plans developed
- Demonstrate expected precision and systematic bias acceptably small
- Evaluator demonstrate experimental bias expected to be acceptably small
- Experiment precision discussed with Requestor to ensure needs met (Area of Applicability verified)
- Resource loaded schedule prepared
- Section 1 and 2 of ICSBEP evaluation drafted (C&DT concurs with draft)
- C&DT issues summary or report to NCSP Manager

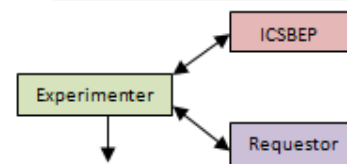
NCSP Man.

- Issues memo approving final design (CED-2)
- Website updated

NCSP Man.

- NCSP Manager authorizes CED-3 initiation
- Should be approved by March to receive funding priority for next FY
- Prioritized and incorporated into funding cycle and 5-Year Plan as appropriate
- Requestor invited to witness experiment (if possible – clearance, funding, etc.)
- Website updated

CED-3: Execution



- Experiment performed
- Data collected
- Section 1 finalized for sending to ICSBEP evaluator
- Experimenter issues summary or report on completion of experiment to NCSP Manager

NCSP Man.

- Approves completion of experiment (CED-3)
- Website updated

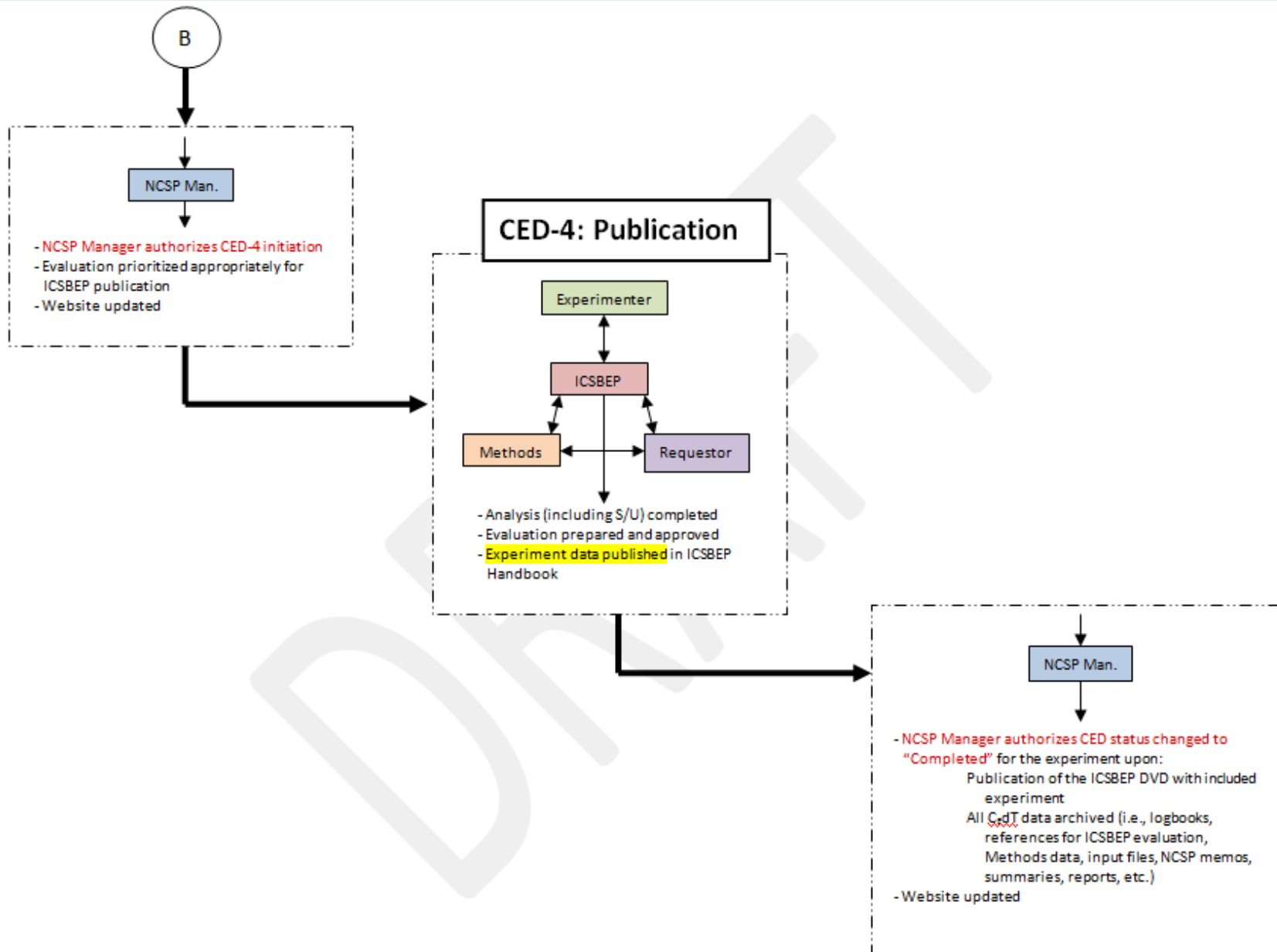
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CED-4a & 4b: Publication of Data

- 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 NCSP Manager approves CED-4, thereby completing the Integral Experiment Request.







Current Status of Proposed Experiments

- 8 Subcritical CEF experiments requests approved/5 awaiting approval
- 1 VNIITF critical experiment in progress/1 awaiting approval
- 1 SILENE critical experiment in progress
- 2 VALDUC critical experiments awaiting approval
- 2 Sandia critical experiment in progress/2 approved/1 awaiting more data
- 5 stockpile science experiment requests approved/3 awaiting approval
- 6 NCT experiment requests approved/2 awaiting approval
- 4 NA-30 experiment requests approved
- 6 additional CEF critical experiment requests approved



Critical/Subcritical Experiment Priorities

- Immediate Criticality Safety Needs
- NA-11/NA-12 – Defense/Nuclear Weapons
- NA-40 – Emergency Ops
- NA-30 – Naval Reactors
- NA-20 – Nuclear Non-proliferations
- Programmatic Criticality Safety Needs
- EM
- NE
- Long Standing Criticality Physics Discrepancies



Critical Experiment Requests – Current

Priority	Comments	Record No.	Request Date	Requestor Name	Experimental Request Title	Status
2010-1snl	In progress at SNL	135	9/7/10	Harms, Gary Alan	Reactor Physics and Criticality Benchmark Experiments for Advanced Nuclear Fuel	CED-3b initiated
2011-1sub	Priority #1 for NNSA	128	1/14/10	Reynolds, Kevin H	Juliett	CED-1 approved
2011-1	First experiment to be performed to garner new data for NCSP, will be done as part of start-up plan	163	4/22/11	Bredeweg, Todd	Reaction rate and fission-product yield measurements with the COMET assembly	CED-1 pending
2011-1v	In progress at VNIITF, will take two years	129	5/20/10	Briggs, J. Blair	Integral Tests of Molybdenum at VNIITF	CED-3b initiated

Critical Experiment Requests – Current (cont'd)

Priority	Comments	Record No.	Request Date	Requestor Name	Experimental Request Title	Status
2011-1snl	In progress at SNL	159	3/2/11	Harms, Gary Alan	7uPCX 0.855 cm Pitch, Pure Water Moderator	CED-3b initiated
2011-2snl	In progress at SNL, being used as part of Pilot Training Course	158	2/21/11	Harms, Gary Alan	Re-establish the Burnup Credit Critical Experiment	CED-3b initiated
2011-1f	Already performed in France but still evaluating data results, then will write it up for ICSBEP	126	11/18/09	Miller, Thomas Martin	SILENE Benchmark Measurements for Criticality Accident Alarm System Analyses	CED-3b initiated
2011-2f	To be performed in France and data not to be released until 2017 unless release signed and part of DOE	170	6/1/11	Briggs, J. Blair	MIRTE-2: Reactivity Characteristics of Cr, Mn, Mo, & Cl, at Thermal Energies	CED-0 pending



What's Next?

- McKamy to approve FY2012 IERs
- Assign Level 2 Milestones to EACH C_EdT step of the process
- Document in the FY2012-2016 5-Year Plan in Appendix D Gant Charts
- Start performing Critical Experiments at CEF gathering new data for NCSP

Critical Experiment Requests – 2012

Priority	Comments	Record No.	Request Date	Requestor Name	Experimental Request Title	Status
2012-1	First PLANET run in its new environment, essential to determine operability & characteristics of the new environment.	137	10/11/10	White, Morgan C	High Precision HEU Critical Assembly Measurements To Understand Reproducibility	CED-1 approved
2012-2	Stockpile data priority	151	1/24/11	Little, Robert C	NCT / NTNF Material # 2	CED-1 approved
2012-3a	Priority to understand facility counting and chemistry as well as new environment for FLATTOP.	136	9/30/10	Bredeweg, Todd	Reaction rate and fission-product yield measurements in Pu-239 and U-238,235	CED-1 pending
2012-3b	Performed concurrent w/136 outside of FLATTOP.	144	11/5/10	Church, Jennifer A.	Time Dependent Assay of Activation Foils (OUO)	CED-0 pending

Critical Experiment Requests – 2012 (cont'd)

Priority	Comments	Record No.	Request Date	Requestor Name	Experimental Request Title	Status
2012-4	1st GODIVA run in new environment. Priority dosimetry exercise with French.	147	1/17/11	Heinrichs, David Paul	Reference values of the Godiva radiation field in DAF	CED-1 pending
2012-5	Physics longstanding issue, NA-10 priority	153	1/25/11	White, Morgan C	Measure The Fission Neutron Spectrum Shape Using Threshold Activation Detectors	CED-1 pending
2012-6	No issues, Follows 136, on FLATTOP	149	1/20/11	Kenneally, Jacqueline	Fission product studies	CED-1 pending
2012-1sub	This will be redone in 2012. The Benchmark will be revised accordingly.	160	6/30/08	Hutchinson, Jesson	Plutonium Sphere Reflected with Tungsten	CED-1 pending



Critical Experiment Requests – 2012 (cont'd)

Priority	Comments	Record No.	Request Date	Requestor Name	Experimental Request Title	Status
2012-2sub	After successful completion of 160, the Benchmarks will be revised accordingly.	106	12/19/07	Mattingly, John Kelly	Polyethylene-Reflected Plutonium Neutron Multiplicity and Gamma Spectral Data	CED-4a Initiated
2012-1snl	Possible first TEX experiment. International CEdT possible based on TEX kick-off meeting in July	117	9/23/08	Kerr, Brad R	Thermal neutron absorption cross-section data for titanium	CED-0 pending
2012-1f	Part of CAAS series of exercises for SILENE, CEF, and CALIBAN, will start design this year	174	6/15/11	Miller, Thomas Martin	CALIBAN Benchmark Measurements for Criticality Accident Alarm System Analyses	CED-0 pending





Questions?

