

# NGNP Component Test Facility Cost and Schedule Report

Battelle Energy Alliance, LLC Idaho National Laboratory

SOW-6392, Revision 0 Contract # BEA 000 75310

May 1, 2009



#### **Title Page**

NGNP Component Test Facility Cost and Schedule Report

Document No. PD-3001289-001

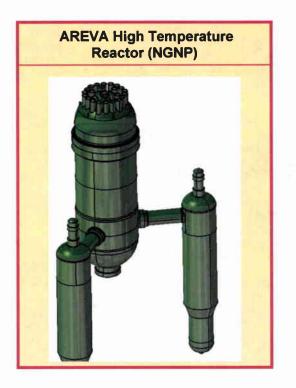
Battelle Energy Alliance, LLC SOW- 6392, Revision 0

May 1, 2009

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#### 1.0 Executive Summary

In accordance with the SOW, AREVA has developed a cost estimate and schedule for the Component Test Facility (CTF), reference INL SOW-6392, Revision 0, "Statement of Work AREVA Component Test Facility Conceptual Design Studies for the NGNP with Hydrogen Production". In addition to the SOW and requirements and references included, AREVA used the INL report "Tailoring Strategy for the HTGR Component Test Facility Project" August 2008 draft document to establish the rationale for compliance with DOE O 413.3A Critical Decisions and major milestones. The AREVA NGNP Component Test Facility Pre-Conceptual Design Report, 12-9097512-001, was used as the technical bases for the development of the CTF cost and schedule.

The cost and schedule include activities necessary to complete the design, construction and initial operation of the CTF and to meet the requirements of DOE O 413.3A. A summary of the resulting cost and schedule are as follows. The total project duration is seven (7) years at a cost of \$ \$389 million dollars not including contingency or fee. Final Design will be complete on September 26, 2012, construction will be complete on October 24, 2014, and commissioning activities will be completed and the facility ready for operations on June 19, 2015.

The key assumptions used in the development of this report are:

- The work scope defined in the AREVA CTF test loop preconceptual design will not be modified.
- The Component Test Facility is considered a non-nuclear industrial test facility and the work will be performed under an industrial non-nuclear QA Program. Application of ASME NQA-1 is not required for the design and construction of the CTF, but will apply to the M&TE used to perform the tests and collect test data during CTF operation.
- Schedule and cost estimate for the 1MWt loop assumes obtaining the HELITE final design work package from AREVA NP SAS.
- DOE accepts AREVA and MHI terms and conditions for use of proprietary intellectual property (IP) before the start of work.
- Key milestones leading up to start of construction shall be in accordance with INL "Tailoring Strategy for the HTGR Component Test Facility Project" August 2008 draft document.

Upon completion of the development of the CTF schedule with the resulting operational date of June 19, 2015, the TDRM schedule was logically connected to determine if the TDRM tests schedules were impacted. (reference Technology Development Road Map Document, TDR-3001031-000, dated November 2008 and TDRM Cost and Schedule Estimate Report, PD-3001185-000, dated December 2008) These documents assumed the 1MWt Loop would be available on October 3, 2011; the 30MWt Loop would be available April 1, 2013, and the construction of the NGNP Plant would be completed by October 1, 2021; reference INL SOW-6636 Statement of Work AREVA FY09-1 Conceptual Design Work for the NGNP with Hydrogen Production. The evaluation of the integration of these schedules determined that a number of the TDRM tests could be delayed until the CTF is available if no mitigation is implemented. The critical tests affected are for the following components:

- Reactor Vessel Internals
- NHS Neutron Control System

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- HTS Compact IHX
- HTS Helical Tube IHX
- Primary Loop Instrumentation
- Hot Gas Ducts
- Helical Tube Steam Generators
- High Temp Isolation Valve

Due to the potential delays to some TDRM tests consideration was given to possible mitigation strategies to minimize any impact to the TDRM Testing schedule revealed during this analysis. Details of this analysis are provided in section 2.3.

## 2.0 Cost and Schedule for CTF Test Loop Design and Facility Construction

In accordance with the requirements in the SOW for the CTF Pre-Conceptual Design, AREVA developed a resource loaded schedule for the design, construction and commissioning of the CTF. The basis of the cost and schedule includes parametric data from similar projects. In some cases it was necessary to rely on engineering judgment based on professional experience for purposes of estimating. The detailed resource loaded schedule and a roll-up is provided in Appendix 1. An annual spending plan is provided in Appendix 2 and the detailed cost information is in Appendix 3.

#### 2.1 Cost and Schedule Development Basis

The AREVA CTF Team was able to use past project information and subject matter experts familiar with EPC for nuclear power plants and systems similar to the CTF test loops and facility. The team was assembled to develop the WBS structure, cost and schedule estimate.

The team evaluated the WBS provided by BEA and work identified in the pre-conceptual design report and expanded the WBS structure and prepared detailed WBS work sheets for each WBS element. The team, in consultation with support staff, reviewed prior work and called upon their prior experience in performance of similar work activities to assure that the WBS structure represented adequate activities for each phase of the project.

For the 1MWt test loop the required SSCs and design are based on the AREVA HELITE test loop. The schedule and the cost estimate for the 1MWt loop assumes obtaining the HELITE final design work package and performing the necessary conversion of the French design for use in the United States to meet applicable U.S.A. codes and standards. The design of the 30MWt test loop is a scaled version of the Japanese HENDEL loop which was used to test the components of the high temperature HTTR test reactor. The cost and schedule estimates developed for the CTF 30MWt test loop is based on the HENDEL experience with the necessary updates for compliance with the U.S.A. codes and standards.

The CTF test loop support systems and the test facility design and construction have been integrated into the cost and schedule based on a consolidated design and construction approach. The initial bases for the cost estimate and schedule was the high level cost and schedule estimate recently performed and reported in AREVA document 12-9076931-000, titled - "NGNP Component Test Facility - Conceptual Configuration, Cost, and Schedule Estimate."

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After developing the CTF test loops and facility schedule logic and durations, resource loading was performed. Cost estimates were developed for each of the WBS elements. Parametric estimating and previous experience were the primary methods used to develop the estimates. When these methods could not be reasonably applied, a professional with experience in the area being estimated was used.

#### 2.2 CTF Work Scope Schedule

High level work activities were defined for each WBS element. Duration and start dates were estimated and the activities were networked using Primavera Project Management scheduling software. Labor and ODC estimates were loaded into the schedule to produce a time-phase spending plan and a profile of the resource demand. Appendix 1 includes the resource loaded schedule.

The CTF design schedule was prepared to be used as the baseline for the conceptual, preliminary, and final design. The schedule also includes estimates of the time it will take for procurement of long lead items, facility construction, test loop installation and the test loop commissioning and turn-over. Following a contract award design engineers will detail the activities to enhance progress and earned value reporting. After commencement of CTF design, additional lower level tasks will be developed and added to the baseline schedule providing additional detail for EVMS. Table 1 below provides a summary of total man-hours by WBS.

Table 1: Man-hour Estimates

WBS ID	WBS Name	Budget Hours
1.1.1	Conceptual Design - 1MWt	5948
1.1.2	Preliminary Design - 1MWt	6606
1.1.3	Final Design - 1MWt	10446
1.1.4	Long Lead Procurement - 1MWt	4000
1.1.5	Construction - 1MWt	2044
1.2.1	Conceptual Design - 30MWt	52616
1.2.2	Preliminary Design - 30MWt	78404
1.2.3	Final Design - 30MWt	112340
1.2.4	Long Lead Procurement - 30MWt	3900
1.2.5	Construction - 30MWt	1736
1.3.1	Conceptual Design - CTF Building and BOP Systems	25454
1.3.2	Preliminary Design - CTF Building and BOP Systems	31050
1.3.3	Final Design - CTF Building and BOP Systems	44442
1.3.4	Construction - CTF Building and BOP Systems	3128
1.4	Commissioning – 1MWt and 30MWt CTF	22982
1.5	Project Management	211236

#### **Key Milestones**

There are six milestones identified in the schedule that reflect key dates for completion of activities. Design reviews at 50% and 90% of each design phase are established to ensure client and DOE input is

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obtained at defined intervals during the conceptual, preliminary and final design process. The milestones are presented in Table 2 below.

Table 2: Key Milestones

Key Milestones			
Activity ID	Activity Due Date		
M0110	CTF Project Start	10/1/08	
M0040	Begin Conceptual Design	10/1/08	
M0140	CD-1 Approve Alternative and Cost Range	3/31/10	
M0190	CD-2/3a Approval of Baseline/LL Procurement	9/30/11	
M0320	CD-3b Approve Start of Construction	10/1/12	
M0330	CD-4 Approve Start of Operations	6/19/15	

#### 2.3 CTF and TDRM Schedule Integration

Upon completion of the development of the CTF schedule with the resulting operational date of June 19, 2015, the TDRM schedule was logically connected to determine if the TDRM tests schedules were impacted. (reference Technology Development Road Map Document, TDR-3001031-000, dated November 2008 and TDRM Cost and Schedule Estimate Report, PD-3001185-000, dated December 2008) These documents assumed the 1MWt Loop would be available on October 3, 2011; the 30MWt Loop would be available April 1, 2013, and the construction of the NGNP Plant would be completed by October 1, 2021; reference INL SOW-6636 Statement of Work AREVA FY09-1 Conceptual Design Work for the NGNP with Hydrogen Production. The evaluation of the integration of these schedules determined that a number of the TDRM tests could be delayed until the CTF is available if no mitigation is implemented. The critical tests affected are for the following components:

- Reactor Vessel Internals
- NHS Neutron Control System
- HTS Compact IHX
- HTS Helical Tube IHX
- Primary Loop Instrumentation
- Hot Gas Ducts
- Helical Tube Steam Generators
- High Temp Isolation Valve

Due to this potential impact consideration was given to possible mitigation strategies to minimize any potential impact revealed during this analysis.

Table 3 below summarizes the TDRM tests to be performed at the CTF that were included in TDRM Cost and Schedule Report. Column 1 identifies the TDRM test as shown in the TDRM Cost and Schedule Report and which test loop is needed for that test. Column 2 identifies the tie between the test and the

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NGNP Plant schedule and why the tie was chosen. Column 3 provides suggested mitigation strategies to minimize the impact. Some of these strategies assume that the test data can be obtained later than what was assumed during the original TDRM Study. This assumption will add risk to the project. Table 3 is organized by the greatest potential impact to the least impact in descending order.

Table 3: CTF Availability Impact to TDRM Test Schedule

TDRM TEST	RELATION TO NGNP PLANT SCHEDULE	MITIGATION OPTIONS
TEST LOOP NEEDED	JUSTIFICATION FOR RELATION	
WBS 1.14.1 BOP Primary Loop Instrumentation TRL 6-7	Complete Test Prior to start of Final Design	Accelerate 1MWt test loop
1MWt Loop	Data needed to confirm Design and Performance Requirements	completion by installing 1MWt Loop in an existing building
WBS 1.4.2 NHS Neutron Control System TRL 5-6	Predecessor to 1.4.3 Below  Input for material properties to 1.4.3 below	Accelerate 1MWt test loop completion by installing 1MWt Loop
MWt Loop WBS 1.4.3 NHS Neutron Control System TRL 6-7	Complete Test Prior to end of Final Design	in an existing building  Locate another Test Facility  Accelerate 1MWt test loop
1MWt Loop WBS 1.12.2	Data needed for Safety Analysis and License application  Predecessor to 1.12.3 Below	completion by installing 1MWt Loop in an existing building Locate another Test Facility
HTS Compact IHX TRL 5-6  1MWt Loop	Input for material properties to 1.12.3 below	Accelerate 1MWt test loop completion by installing 1MWt Loop in an existing building
WBS 1.12.3 HTS Compact IHX TRL 6-7	Complete Test Prior to end of Final Design	Locate another Test Facility
30MWt Loop	Data needed to confirm Performance Requirements	Use supplemental analyses in lieu of testing and accept increased risk  Have Equipment Supplier perform
	Data needed prior to fabrication	the test
WBS 1.8.1.4 Tube IHX Large Component Test	Complete Test 18 Months Prior to end of Final Design  Data needed for Safety Analysis	Use supplemental analyses in lieu of testing and accept increased risk
30MWt Loop	and License application	
	Data needed to confirm Performance Requirements	1
	Data needed prior to fabrication	

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TDRM TEST TEST LOOP NEEDED	RELATION TO NGNP PLANT SCHEDULE JUSTIFICATION FOR RELATION	MITIGATION OPTIONS
WBS 1.9.2.1 Primary Hot Gas Duct Engineering Scale Demo 30MWt Loop	Complete Test 18 Months Prior to end of Final Design  Data needed for Safety Analysis and License application  Data needed to confirm Performance Requirements  Data needed prior to fabrication	Locate another Test Facility  Use supplemental analyses in lieu of testing and accept increased risk
WBS 1.11.1.2 High Temp Isolation Valve TRL 6-7 30MWt Loop	Complete Test 18 Months Prior to end of Final Design	Locate another Test Facility  Rely on Vendor Technology and Testing Experience  Delay Installation and Proceed with NGNP Design and Construction. Until Valve is tested and installed use alternative loop operations and accept Licensing Risk
WBS 1.2.3.2 Reactor Vessel Internals Data collection for Conduction Cool down Analyses  1MWt Loop	Complete Test 18 Months Prior to end of Final Design  Data needed for Safety Analysis and License application	Locate another Test Facility  Accelerate 1MWt test loop completion by installing 1MWt Loop in an existing building
WBS 1.13.2.3 Helical Tube Steam Generator Engineering Scale Demo 30MWt Loop	Complete Test 18 Months Prior to end of Final Design  Data needed to confirm Performance Requirements  Data needed prior to fabrication	Use supplemental analyses in lieu of testing and accept increased risk  Have Equipment Supplier perform the test

The following is a summary of options that could mitigate the impacts of the schedule delays.

- Separate the 1MWt test loop from the 30MWt loop and place them on separate funding paths where the 1MWt loop could be commissioned ahead of the 30MWt loop. This will result in only minor improvements and is not recommended.
- 2. Placing the 1MWt loop in an existing facility to accelerate the 1MWt loop availability. On its own this option only results in a 3 month improvement. If this option is taken and the milestones included in the Tailoring Strategy for the HTGR Component Test Facility Project are removed, the schedule can be improved by 23 Months for the 1MWt Loop test. The 1MWt Loop would be operational in July 2013. This still has the availability of the 1MWt Loop 21 months later than the October 2011 need date and does not provide any improvement in the 30MWt Loop schedule.

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- 3. Privatize the test facility by awarding the contract for the tests to an entity that would be willing to use the contract award to provide the test facility outside of the DOE funding process.
- 4. Reevaluate the test data needs and test methodology to see if alternatives (i.e. analysis verses testing) can be identified that could be accomplished without the CTF.
- 5. Pursue alternate locations for the tests.

Options 3 and 5 provide the timeliest test information, but it is still an unknown if they could be put in place to support the estimated CTF needs dates. The probability of being able to implement option 3 is low. As a part of the TDRM Study alternate test facilities were considered. There is a higher probability that alternate test locations for the 1MWt test could be found inside and outside of the United States. There is a lower probability that an alternate test facility could be found for the critical tests scheduled for the 30MWt Loop and they would most likely be from foreign sources if they exist at all. Both of these add risk to the project of having to use outside sources rather than internal sources.

Option 4 could be done in a relatively short time and may prove beneficial in identifying alternates that may have been eliminated during the TDRM study, but now, while not ideal, may be more desirable than delaying the project.

#### 2.4 CTF Work Scope Cost

The WBS tasks were evaluated to determine the skill sets, qualifications, and staffing levels required to execute the tasks. Based on the results of the evaluations the man-power loading was established and the resources were allocated accordingly into the schedule. In addition to the direct labor cost, ODCs including travel and miscellaneous ODCs were included in the estimate. This is a pre-conceptual cost estimate. The costs reflected in this report do not include contingency and fee. Appendix 3 includes the WBS Dictionary Element Definition sheets. The level of confidence with the cost estimates are identified in each WBS element sheet.

#### 2.4.1 Basis of Estimate

#### 2.4.1.1 1MWt Test Loop Installation Costs

For the 1MWt test loop major components were evaluated for method and difficulty of installation and then on an individual basis, an estimate of the labor and material costs needed for installation was developed. Based on the size, material, component type and complexity of installation, assumptions on craft labor, handling equipment, consumables, linear feet of pipe, number of pipe supports, number of welds, quantity of steel shapes and miscellaneous materials needed to install the component were made. ASME B31.3 and the IBC were used as the governing codes for installation.

The methodology used to estimate the installation cost was based on best-estimates for materials cost including anchors, weld filler materials, piping, bolting, steel structural shapes, etc.

The installation labor estimate included weld prepping of the special double wall insulated piping and fittings, weld fit-up, welding and Non-Destructive Testing (NDT) including Radiograph Testing, based requirements stated in ASME B31.3. The "Estimator's Piping Man-Hour Manual" Fifth Edition was used as practical with additional time based on estimator's experience of welding durations times while maintaining weld interpass temperatures throughout the welding process and field Radiography the weld joints. Support structures and piping supports have not been designed therefore engineering judgment was applied based on best-estimates from estimator's past experiences on similar components and piping. A correction factor of 1.25 was applied to the welding and NDT labor estimates to account for the

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developmental cost associated with welding the double wall insulated piping and fittings and Radiographic processes.

The labor cost also included estimated effort and materials for transporting materials from delivery trucks to storage and from storage to the work site. Equipment rental costs (obtained from rental agency) such as scaffolding, personnel lifts, mobile cranes, fork lifts, etc. were also included. Labor to operate this equipment was estimated based on estimator's previous experiences. Costs were estimated for insulating and painting of carbon steel structures as appropriate. A labor rate of \$120/hr was assumed.

#### 2.4.1.2 30MWt Test Loop Installation Costs

For the 30MW test loop the detailed installation cost estimate for the 1MWt loop was used as a basis for installation costs as follows. Based on the 1MWt loop detailed estimate, a relative cost of installation verses component cost was calculated to be 70%. This factor was evaluated for applicability to the 30MWt loop and it was determined that due to the high equipment cost the installation factor should be reduced to 50% for the 30MWt loop installation cost.

#### 2.4.1.3 1MWt Test Loop Component Costs

The estimates of the 1MWt Test Loop component cost were developed using input from several sources. The costs for the major components are primarily based upon scaling of the SAS HELITE costs. Component costs from the HELITE design were scaled and adjusted to accommodate the CTF 1MWt design requirements and multipurpose configuration. The costs for the remaining smaller components and associated "off the shelf type" equipment is based on the required quantity or length, vendor quotes and or catalog pricing. Based on the quality of these inputs, the confidence level in these costs is relatively high.

#### 2.4.1.4 30MWt Test Loop Component Costs

The 30MWt Test Loop Component costs include the costs for the forging, machining and final assembly of the major components as well as their associated control systems. The cost estimates were based on the supplier's experience and expertise in the design and manufacturing of components of similar scale and complexity. The following design considerations were used in the development of the component costs.

The estimates of the 30MWt Test Loop component cost were developed based on the following assumptions:

- 1. Sub-contracting: This vendor cost includes costs of sub-contractors for pressure vessels and attachments. The sub-contractor performs manufacturing design, procurement of materials, manufacturing, testing and inspection.
- Assembly finishing and Fabrication: Final assembling of Heater element and internal parts of
  pressure vessel with inner insulation structure is performed. Final Machining of flanges of
  pressure vessel and final PWHT of pressure vessels are performed. These costs are included in
  this cost item.
- 3. Insulation (including liner): This cost includes material and manufacturing and assembling costs by sub-contractor.
- 4. Graphite cost of heater elements: Material cost and final machining cost by subcontractor are included in this cost.
- Design, material procurement, and manufacturing for Control Equipment are performed by subcontractor.
- 6. Export packing and Inland transportation: Export packing and Inland transportation cost for the Primary Hot Gas Ducts also includes the cost for the Secondary Hot Gas Ducts.

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- 7. Design engineering: Project Management cost including travel expense is included in this cost item.
- 8. Assembly finishing and Fabrication at MHI's work shop: Common cost for the Quality Assurance (excluding quality control) and staff cost for manufacturing are included in this cost item.
- 9. Export packing and Inland Transportation: FOB cost for all the components is included in this cost item

#### 2.4.1.5 CTF Building and Services

The CTF building cost estimate including construction labor, building materials and BOP equipment. The building cost was separated into three area costs; 1MWt, 30MWt and site improvements.

Included are site prep, foundation, building structure and systems such as Fire Protection, HVAC, cooling towers, lighting and electrical. A central control room for both loops was also estimated. The cost estimate was based on approximately 85% parametric data and 15% from RS Means. (reference Cost Estimate Support Data Recapitulation for the CTF, prepared by BREI, 3/18/08)

The total estimated CTF building cost of \$ 67,113,284 includes \$37,775,867 for construction labor and \$29,337,439, for equipment and materials.

The facility layout for the test loops included consideration of the following items:

- The components which constitute the hot helium boundary are grouped within partitioned rooms to limit the consequences of a hot helium leak.
- The instrumentation and electric equipment which are sensitive to temperature are located within air-conditioned rooms. The rooms are located closely to each other to reduce the cable length.
- Monorail lines shall be laid down in the center of the buildings to provide transportation routes for the equipment which are brought into and out of the buildings when construction or maintenance operations are engaged.
- · Components shall be installed on the first floor. They shall not be tiered
- Any components which are suitable for installation outdoors are located outdoors to reduce congestion and the size of the building.

The following estimating methodologies were used to define the activities, quantities, and resources used in the preparation of this cost estimate.

- A. The project scope and methodologies for this estimate were prepared from pre-conceptual design documents.
- B. An upper-level WBS was used to establish the structuring of the work.
- C. The NGNP Preliminary Design estimate is the basis for the CTF. The CTF buildings are based on the NGNP Radwaste Building (concrete structure) and the NGNP Administration Building (metal sided structural steel). Quantities were scaled as necessary to suit the CTF design. Material costs from the NGNP estimate were escalated to current day dollars. Activity descriptions and costs are based upon these individual detailed item quantities.
- D. Labor hours from the NGNP estimate were used as is. All were factored for productivity. Current labor rates were applied.
- E. INL provided the craft wage rates in an April 18, 2007 e-mail. Wage rates are fully burdened with FICA, SUI, WC, etc and also include a \$19.00 per diem cost. Rates are escalated to 2008.
- F. Craft labor will work a 4-10's workweek.
- G. Cost of overtime is not included.
- H. Central Facility Area (CFA) at no cost to the project will accept excavated spoil.
- 1. Cost of defining, excavating and transporting contaminated soil is not included.
- J. Fill material will be furnished to the project at no cost by CFA.
- K. Unit pricing, as required, was obtained from RS Means cost data books, "Trade Services Pricing" book, vendor quotes, vendor price lists and historical data.

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- Local vendors were polled for preliminary quotes for supply of concrete, reinforcing steel and structural steel for NGNP.
- M. Idaho Sales Tax of 6% is included for bulk materials and process equipment.
- N. Freight of 5% is included for bulk materials and process equipment.
- O. A design review was held March 17, 2008 with the AREVA PM to review and provide consensus of agreement as to the perceived scope of work, assumptions, risks, and costs as engineered and assembled by this estimate.

#### 2.4.2 Cost of Money

All cost values are in 2008 dollars; no cost of money is planned for future dollar valuations.

#### 2.4.3 Spending Plan

Appendix 2 provides the annual estimated costs by third level WBS.

#### 2.4.4 Other Direct Costs (ODC)

ODCs are other costs that have not been included in proposed material, direct labor, indirect costs, or any other category of cost. ODCs include but are not limited to: travel expenses, temporary living expenses, relocation expenses, packaging and transportation costs, royalties, computer expenses, and reproduction costs. The following summarizes ODCs for the CTF Engineering design, facility construction, and loop installation and commissioning.

#### Travel

Travel costs include the costs of transportation, lodging, and meals and incidental expenses (M&IE) incurred by employees while on project required travel. Travel estimates are based on the potential number of trips as a factor of staff size and work activity durations and places to be visited (domestic or international). Travel costs associated with specific tasks are budgeted in ODCs within the specific WBS tasks.

#### **Shipping Costs**

A major part of these costs are an allowance for shipping of equipment from Japan and France. It also includes the transmittal of documents and other materials between design locations. It is assumed that most documents will be transmitted electronically and reproduced at the receiving location.

#### **Reproduction Costs**

These costs are an allowance for reproduction of programmatic documents, standards, drawings, and other items for dissemination and review among design team personnel.

#### 2.4.5 Contingency

Contingency is not included in the resource loaded schedule. Based on the following risk items, AREVA believes an appropriate contingency would be 30%.

Risk Items for Completion of Component Test Facility:

 Availability of funding to proceed with all activities in the sequence as provided in the work plan.

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- Changes in the CTF reference configuration as detailed in AREVA recommended CTF Test Loop Pre-Conceptual Design Report (12-9097512-001).
- Delay in completion of interface activities such as long lead component manufacturing and delivery.

#### 2.4.6 Fee

There is no fee included in the estimated project cost.

#### 2.4.7 Proprietary Intellectual Property (IP)

The use of IP associated with 1MWt test loop and the design of its key components (i.e. the circulator, leak tight seals, and Helium purification system) is limited to the NGNP component test facility. DOE may not resell, transfer, or license the 1MWt test loop design or its key components to a third party.

The 1MWt test loop cost estimate is based on these limited rights of use. The co-owners of the HELITE test loop (AREVA NP SAS and its partners) agreed in principle to sell the limited rights of use for the HELITE test loop design only. The ownership of the associated IP remains with AREVA. In addition, the IP associated with the manufacturing of the following key test loop components (i.e. the circulator, leak tight seals, and the helium purification system) is not transferred. For the remainder of the 1MWt test loop design package, DOE will have full rights of use such as for other applications and license to third parties.

AREVA proposes to sell the design and qualification data files for the amount estimated in this cost and schedule report. If unlimited full rights of use are requested by DOE the price must be renegotiated.

The use of IP by DOE associated with the 30MWt test loop is limited to the NGNP component test facility. DOE may not resell, transfer, or license the 30MWt test loop design or its key components to a third party. The ownership of the associated IP remains with Mitsubishi Heavy Industries, LTD. (MHI).

#### 3.0 Assumptions

The following assumptions were made in the development of the Component Test Facility Cost and Schedule Report:

- Funding will be provided to meet the cash flow identified. Funding below that level will affect both the
  efficiency of performing the work tasks and the critical path schedule.
- Long lead procurement activities will begin in the preliminary design phase.
- The CTF will be built at the INL site.
- Costs are in 2008 dollars with no escalation.
- Financial conversion rates of \$1.3/Euro and \$.01/Yen.
- Average labor rates of \$140/hour.
- No costs are included for installation of transmission lines to site.
- No costs are included for stand by power.

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- 5 months has been allowed for completion of a contractor and DOE ORR. This time frame is significantly shorter than is typical for an ORR at a nuclear facility and assumes less rigor will be required for a facility like the CTF with only industrial hazards.
- The work scope defined in the AREVA CTF test loop preconceptual design will not be modified.
- Component Test Facility is considered a non-nuclear industrial test facility and the work will be
  performed under an industrial non-nuclear QA Program. Application of ASME NQA-1 is not required
  for the design and construction of the CTF, but will apply to the M&TE used to perform the tests and
  collect test data during CTF operation.
- Schedule and cost estimate for the 1MWt loop assumes obtaining the HELITE final design work package.
- Travel Cost per person is \$1500 for domestic travel and \$5000 for international travel.
- DOE accepts AREVA and MHI terms and conditions for use of proprietary intellectual property before the start of work.
- Key milestones shall be in accordance with INL "Tailoring Strategy for the HTGR Component Test Facility Project" August 2008 draft document.

#### 4.0 Risk

Risk management is a continuous process that identifies, analyzes, prioritizes, mitigates and tracks project risks. The scope of risk management applies to all phases of the CTF project: design, construction, commissioning and turnover, and operation.

AREVA expects the risk associated with the construction of the CTF to be limited to normal construction and component manufacturing risks. The facility is a standard industrial non-nuclear facility that contains industrial type hazards (pressure & temperature) which will be factored into the facility design. The hazards are readily identifiable and do not require complex mitigation strategies.

The risks associated with the design and fabrication of the test loops and the test loop components are minimal. The 1MWt test loop is modeled after the HELITE test loop of similar configuration, which is designed to European standards. The cost estimate for the 1MWt loop was based on the cost to purchase the "design" from AREVA and the additional cost to Americanize and modify the design. The design documents must be translated into English. The design must then be updated to meet the applicable U.S. codes and standards, and modified to provide a second loop and additional test capabilities needed for the CTF application. The 30MWt test is similarly based on a HENDEL test loop design.

The design of test loop critical components has been established through internal R&D by AREVA and MHI during the development of the HELITE and HENDEL designs. These components, however, have been identified on the long lead components list and their manufacturing and fabrication must be started early to meet the proposed schedule requirements.

A lack of continuous project funding would result in an adverse schedule perturbation and possible loss of critical design team members.

NGNP Component Test Facility Cost and Schedule Report Document No. PD-3001289-001 **Appendices** May 1, 2009

#### Appendices

Appendix 1 – Resource Loaded Schedule Appendix 2 – CTF Spending Plan Appendix 3 – WBS Dictionary

# Appendix 1 – Resource Loaded Schedule

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on for	Activity Name	Dur Start Firsth	Fibel	M Hours		Budget	2009	2010	20 03 04 01 02	2012	2013	20 00 00	2015
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M0040	Begin Conceptual Design	0m 10/1/08*		3m C	£		Begin Conceptual Des						
M0140	CD-1 Approve Alternative and Cost Range	0m 3/31/10		0 00	oh	\$0		◆ CD-1 Approve America					
M0190	CD-2/3a Approval of Baseline/LL Procurement (INL 9/30).	0m 9/30/11	٠,	0 E0	£	\$0			◆ CD-2/3a Approval of	oval of			
M0150	TDRM Early Need Date - 1MW CTF	0m 10/3/11	4	48m C	-B	\$0			◆ TDRM Early Need Date	sed Date			
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M0320	CD-3b Approve Start of Construction (INL 9/30/2012)				ю	. \$0				<b>⊕</b> CD-9	◆ CD-3b Approve Start		-
M0340	TDRM Early Need Date - 30MW CTF				oh Oh	S					◆ TDRM Early Need Date	eed Date	
M0330	CD-4 Approve Start of Operations	0m 9/16/15		0m m0	Ę.	05							
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101011	Conceptual Design Interface w/R&D - 1MW CTF				eh G	0\$		Conceptual Design In-					
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1CD1170	Develop Design Description for Primary Loop	5m 10/1/08 2/27/09	ł		Ť.	\$0	Develop Design Descr.	3CF					
1CD1140	Develop Design Description for Secondary Loop	5m 10/1/08 2/27/09			ų,	\$0	Develop Design Descr.	Scr					
1CD1100	Specifications for Low Temp Piping - 1MW				ş	05	Specifications for				71		
1CD1090	Design Description for Test to op Configurations				oh O	\$00	<ul> <li>Design Description f.</li> </ul>	1					
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1001000	Develop Equipment Design Specifications		ľ		ų	\$0	Develop Equipment De	t De					
1CD1060	System Specification for Transients - 1MW	2/27/09			,	\$0	System	System Specification					
1CD1020	Develop P&IDs		_		-h	\$0		Develop P&IDs					
1CD1010	Develop Process Flow Diagram				ų.	\$0	Develop	Develop Process Flow .					
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Specific description         6 m 9/29/10         2/25/11         4 m         0 h         50         Perform Modestrials         Perform Modestrials         Control of the control o	Select   Americal   30AW   6m   9/29/10   2/25/11   4m   0h   50   0h   6/27/11   1m   0h   50   0h   6/27/11   0h   11984h   51/28465   0h   51/28465   0h   6/27/11   0h   0h   50   0h   6/27/11   0h   6/27/12   0h   6/27/11   0h   6/27/12   0h   6/27/1	are Drawings for
Pergane Disorder   Pergane Disorder   Pergane Disorder   Pergane Disorder Dawing for	See of Newtonian Control and Say 12 (127) 11 am 0h 50 0	erform hodustria S
Frequency   1900   19	Or Secondary Loop Pipting = 30MW	
House   March   Log Piping   30MW   6m 9/29/10   6/27/11   1m   0h   50   50   6m 10	Foreigner	Prepare Urawn Cor
Property   State   Property   P	Pearly   Street   S	Prepare Drawings for
Policy   P	Pleater 1	PD for Deserator
Pump         9m 9/29/10 6/27/11 im         0h         \$0           Water lank         9m 9/29/10 6/27/11 im         0h         \$0           Water lank         9m 9/29/10 6/27/11 im         0h         \$0           Man 9/29/10 6/27/11 im         0h         \$0         Portion Condensate Wa           Specifications         9m 9/29/10 6/27/11 im         0h         \$0           Specifications         5m 9/29/10 6/27/11 im         0h         \$0           Specifications         5m 9/29/10 6/27/11 im         0h         \$0           Specifications         5m 9/29/10 6/27/11 im         0h         \$0           Applied of Condensate Control Posumary - 30MW CTF imm 4/1/10 6/27/11 imm 0h         \$0         \$0         \$0           Applied of Control Posumary - 30MW CTF imm 4/1/10 6/27/11 imm 0h         \$0         \$0         \$0         \$0           Applied of Control Posumary - 30MW CTF imm 4/1/10 6/27/11 imm 0h         \$0         \$0         \$0         \$0         \$0           Control Posumary - 30MW CTF imm 4/1/10 6/27/11 imm 0h         \$0         \$0         \$0         \$0         \$0         \$0         \$0         \$0         \$0         \$0         \$0         \$0         \$0         \$0         \$0         \$0         \$0         \$0         \$0 </td <td>Pump         9m 9/73/10 6/27/11 1m         0h         50           Water Tank         9m 9/73/10 6/27/11 1m         0h         50           Water Tank         9m 9/73/10 6/27/11 1m         0h         50           Specifications         9m 9/73/10 6/27/11 1m         0h         50           Specifications         5m 3/29/11 8/73/11 1m         0h         50           Specifications         5m 3/29/11 8/73/11 1m         0h         50           Annual Tank         7m 3/29/11 8/73/11 1m         0h         50           Annual Tank         7m 3/29/11 8/73/11 0m         0h         50           Annual Tank         15m 4/1/10 6/27/11 0m         0h         573,125      <tr< td=""><td>PD for Feed Water He</td></tr<></td>	Pump         9m 9/73/10 6/27/11 1m         0h         50           Water Tank         9m 9/73/10 6/27/11 1m         0h         50           Water Tank         9m 9/73/10 6/27/11 1m         0h         50           Specifications         9m 9/73/10 6/27/11 1m         0h         50           Specifications         5m 3/29/11 8/73/11 1m         0h         50           Specifications         5m 3/29/11 8/73/11 1m         0h         50           Annual Tank         7m 3/29/11 8/73/11 1m         0h         50           Annual Tank         7m 3/29/11 8/73/11 0m         0h         50           Annual Tank         15m 4/1/10 6/27/11 0m         0h         573,125 <tr< td=""><td>PD for Feed Water He</td></tr<>	PD for Feed Water He
Polity   P	Water Tank   Strate	PD for Feed Water Pu
Signature   Sig	Water Tank.  9 m 9/24/10 6/27/11 1m 0h 50  10 for Secondary Loop Electrical - 30kW 4m 1/27/11 5/26/11 1m 0h 50  Specifications  5 m 3/29/10 6/27/11 1m 0h 50  Specifications  5 m 3/29/10 6/27/11 1m 0h 50  Specifications  5 m 3/29/10 6/27/11 1m 0h 50  Isomorphy 10 m 1/29/11 1m 0h 50  Isomorphy 10 m 1/29/11 1m 0h 50  Isomorphy 10 m 1/29/11 1m 0h 1/20  Isomorphy 10 m 1/29/11 0m 0h 50  Isomorphy 10 m 1/29/11 0m 0h 57/11/20  Isomorphy 10	DD for Conference Wa
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Final Design Completed - 30MW CTF	Final Design Completed - 30MW CTF	Final Design Summary.
Page 1   Page 1   Page 2   Page 3   P	A.1. 304MV CTF Design Requirements         9 m 10/3/11 6/32412         6 m 500h         573,1           0         3.000MV Final Design Requirements Summary - 300MV CTF         9 m 10/3/11 6/3/12         6 m 500h         573,1           From Transfer Design Requirements Summary - 300MV CTF         9 m 10/3/11 6/3/12         6 m 500h         573,1	◆ Fina Design Complet
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State   Stat	OTF12.5 Construction	n - 30MW CTF		10/20/14	-		66,995					10/20/14, CTF1.2.5
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A continue of the change of	15m 4/1/10   6/27/11   3m 17700h   52.201,130   15m 4/1/10   6/27/11   3m 17700h   52.201,130   15m 4/1/10   6/27/11   3m 17700h   52.201,130   15m 4/1/10   6/27/11   3m 17700h   52.201,130   15m 4/1/10   6/27/11   3m 17700h   52.201,130   15m 4/1/10   6/27/11   3m 17700h   52.201,130   15m 4/1/10   6/27/11   12m 0 h   50   10m 10 h   10	CTF132	reliminary Design	15m 4/1/10	6/27/11			059 011			6/27/11	GTF1.3.2 P				
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spenicy Power System         4m 6/1/10         9/28/10         12m         0h         \$0         Polytic Energy           Protection System         4m 6/1/10         9/28/10         12m         0h         \$0         Polytic Energy           Protestion System         2m 7/30/10         9/28/10         9m         0h         \$0         Protestion Englance Equity           Replace Edul         2m 7/30/10         9/28/10         9m         0h         \$0         Protestion Englance Edul           Remaining Work         4 Milestone         Protestion Englance Edul         Protestion Englance Edul         Protestion Englance Edul         Protestion Englance Edul	Table   Tabl	1001		2т 4/1/10	5/31/10	16m	oh	\$0		Prepare Site Dra	wing					
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Fig. 19   Fig.			Author Manie	PALL POLICE		L		Thinks .	2012	2006
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The first of the f		2PD2520	PD for Make-up Water System					-	PD for Male-up Water	
Continued Statistics (continued Statistics)   Size (A)/100   Size (1)   Size (A)/100   Size (1)		2PD1690	PD for Purified Water Production System						PD for Pur fied Wate	
Compared of September   Comp		2PD1511	PD for Helium Sampling System	4/1/10	27/11			-	PD for Hellum Sampli	
		1003300	PD for Nitrosan Gas System (common 1830MW)	4/1/10	14/92				PD for Mtrogen Gas	
Command Supply Septem (common 1 180 ANY)   Command Supply Septem (		1002200	DO for Compressed Air Sector (common 19.30844)	4/1/10	26/11				PD for Compressed M	
Cheese Special permits permit		1000000	and the second s	4/4/40	20,11			0 1	PD for Waste Water	
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Figure 15   Figu		1PD2230	PD for Cooling Water System (common 1&30MW)	4/1/10				0	Policy County Water	
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This		1PD2210	PD for He Purification System (common 1&30MW)	4/1/10				0	Policy me rumination	
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This is principle to the control of the control o	CI	133 Final E	Jestign		**			10	9/26/12, CIF13.3 F	
Building Section   Building Se	U	TF133.1 Bull	Ging and Utilities FD		26/12			P	9/24/12, CFF1.3.3.1	
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Fig. 10 to the standard content stand		1503400	Circlist Control Boom   months					) r	Finalize Control Rop	
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17 of real wite west play years   18 m 12/11   27 k   12 m		1FD2500	FU for Main Power System	1/31/17	77/97			2	CO - Feet Water C	
Fig. 10   Fig.		1102490	FD Tor Presh Water Supply System		77/97			9		
Dis Frience on System   Smith   1912   2912   3 m   0 h   500   1914   1915		1FD2480	FD for Emergency Power System		75/12			0	Mod April Europe De la Company de la Company	
Proceedings		1FD2470	FD for Fire Protection System	1/31/12	726/17			0	FD for Fire Protects	
10   10   10   10   10   10   10   10		1FD2460	FD for HVAC System		~			0	FD for HVAC System	
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Subport System 15 Submary - 30MM CTF 50 m 10/3/11 6/78/12 6m 0 h 55 an 10/3/11 6/78/12 6m 0 h 55 an 10/3/11 6/78/12 6m 0 h 55 an 10/3/11 6/78/12 6m 0 h 55 an 10/3/11 6/78/12 6m 0 h 55 an 10/3/11 6/78/12 6m 0 h 55 an 10/3/11 6/78/12 6m 0 h 55 an 10/3/11 6/78/12 6m 0 h 55 an 10/3/11 6/78/12 6m 0 h 55 an 10/3/11 6/78/12 6m 0 h 55 an 10/3/12 6/78/12 6m 0 h 56 an 10/3/12 6/78/12 6/78/12 6/78/12 6/78/12 6/78/12 6/78/12 6/78	9	TF1.3.3.2 Sup	bort Systems FD	10/8/01	H	w	Щ	lin.	6/28/12, CF1 3 3 2	
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10 to the buyer system		2FD3000	FD for Pressurized Cooling Water System		~			0	FD for Pressurized C	
Fig for the Limit Sampling System   Smith of Marker   Smith of M		2FD2990	FD for Make-up Water System	10/3/11				0	FD for Male.	
Fig for the fund Sampling System   Properties of the Standard Sampling System   Properties System (common 1830MW)   Properties System (c		2CD1700	FD for Purified Water Production System	10/3/11	~			0	FD for Pur fied Wate	
For this region of Ses System (common 1830MW)   For 10/3/11 5/29/12   Adm   Oh   S0   S0   S0   S0   S0   S0   S0   S		2CD1520	FD for Helium Sampling System	10/3/11	~			0	FD for Hellum Sampli	
Figure   F		1FD2750	FD for Nitrogen Gas System (common 1&30MW)	10/3/11	~			0	FD for Nitro an Gas	
FD for Hear Trace System (common 18.30MW)		1FD2740	FD for Compressed Air System (common 1&30MW)	10/3/11	~			0	FD for Compressed Ai	
FD for Wate Wate Treatment (common 1830MW)   8m   10/3/11   5/29/12   40m   0h   50		1FD2730	FD for Heat Trace System (common 18,30MW)	10/3/11	~			0	FD for Heat Trace Sy.	
FD for Chemical Supply System (common 1830MW)   8m 10/3/11 5/29/12   40m   0h   50   50   50   50   50   50   50		1FD2720	FD for Waste Water Treatment (common 1&30MW)	10/3/11				0	FD for Water T.	
FD for Cooling Water System (common 1830MW)  FD for Les Storage and Supply System (common 1830MW)  FD for the Storage and Supply System (common 1830MW)  FD		1FD2710	FD for Chemical Supply System (common 1&30MW)					0	FD for Chemical Supp	
FD for He Storage and Supply System (common 18.30MW)   8m 10/3/11   5/29/12   40m   0h   \$0   \$0   \$0   \$0   \$0   \$0   \$0		1FD2680	FD for Cooling Water System (common 1&30MW)	10/3/11				0	FD for Cooling Water	
FD for the Purification System (common 1830MW)   Bm 10/3/11   5/25/12   40m   0h   5/25/14   5m   2380h   55/25/14   5m   2380h   5m   2380h   5m   2380h	Ш	1FD2670	FD for He Storage and Supply System (common 1&30MW)					0	FD for He Storage an	
State   Stat		1FD2660	FD for He Purification System (common 1&30MW)					0	FD for He Purificati	
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Critical Remaining Work	2	emaining Lev	Remaining Work	◆ Milestone				Page 7 of 9	TASK filter: CTF - Exclude Working Milestones.	
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	2CN1210	480V Power Systems	6m 8/27/13	3 2/24/14	5m	db	80		ystems
	2CN1200	600V Cabling	2m 8/27/13	3 10/25/13	10m	ь	20	600V Cabing	
	2CN1190	Lighting and Power	4m 8/27/13	3 12/25/13	7m	40	20	Lighting and Power	_
	2CN1240	Communications	1m 12/25/	1m 12/25/13 1/24/14	m/	ч	So	☐ Communications	LO.
- 4	2CN1230	Grounding	1m 12/25,	1m 12/25/13 1/24/14	7m	6	20	Grounding	
	2CN1220	480V Motor Control Center	1m 2/24/14	4 3/26/14	ES	٩	20	■ 480V Motor Control C	Control
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	CTF1 3.4.2 Bulk	ding Furnishings	20m 10/1/12	ш	5m	440h	\$603,958	¥ 5/26/14, CIF1.34.2	, CIR13.42
	20880	Site, Bldg, Bldg Svcs Construction Summary	20m 10/1/12	.2 5/26/14	Sm	440h	\$603,958	Site, Bid.	Site, Bidg, Bidg Svc
	2CN3170	Procure Equipment Room Furnishings	9m 10/1/12	2 6/27/13	14m	ф	So	Program Equipment Ro.	
	2CN3160	Procure Shop Furnishings	9m 10/1/12	.2 6/27/13	14m	ų	05	Procure Shop Furnish	
i	2CN2740	Procure Office Furnishings	9m 10/1/12		14m	oh	20	Procure Office Furni.	
	2CN2735	Procure Control Room Furnishings	9m 10/1/12		14m	ų	\$0	Procure Centrol Room.	
	2CN3190	Install Equipment Room Furnishings	2m 3/26/14		E	6	20	■■ Install Eq	Install Equipment Ro
	2CN3180	Install Shon Furnishings	2m 3/26/14		E	-6	05	Install Sh	Install Shop Furnish
	2CN2760	Install Office Furnishings	2т 3/26/14		E	9	So	Install O	Install Office Furni
	2CN2750	Install Control Room Furnishings	2m 3/26/14		Sm	oh	\$0	Install Te	Install Control Room
H	CTF1.3.4.3 Supp	port Systems 1MW	15m 10/1/12	2 12/25/13	10m	308h S	\$6,477,220	12/25/13, CTF13,43	4.3
-	51040	Support Systems Construction Summary	15m 10/1/12	2 12/25/13	10m	308h \$	\$6,477,220	Support Systems Cons	ons
	2CN3165	Procure Pressurized Cooling Water System Mat'ls	9m 10/1/12	.2 6/27/13	13m	ų,	20	Procure Presurised	
	2CN3155	Procure Make-up Water System Mat'ls	9m 10/1/12		13m	ф	20	Procure Make-up Wate-	
4	2CN1710	Procure Purified Water Production System Mat'ls	9m 10/1/12	.2 6/27/13	13m	ь	\$0	Procure Purified Wat	
	2CN1530	Procure Helium Sampling System Mat'ls	9m 10/1/12	2 6/27/13	13m	8	SD	Procure Helium Samiol.	
	1CN3370	Procure Nitrogen Gas System (common 1&30MW)	9m 10/1/12	.2 6/27/13	10m	0h	\$0	Procure Ntrogen Gas	
	1CN3360	Procure Compressed Air System (common 18,30MW)	9m 10/1/12	.2 6/27/13	13m	Ą	\$0	Procure Compressed A.	
	1CN3350	Procure Heat Trace System (common 1&30MW)	9m 10/1/12	2 6/27/13	13m	ю	\$0	Procure Heat Trace S.	
	1CN3340	Procure Waste Water Treatment (common 1&30MW)	9m 10/1/12	2 6/27/13	13m	ф	0\$	Procure Waste Water	
Ļ	1CN3330	Procure Chemical Supply System (common 1&30MW)	9m 10/1/12		13m	40	0\$	Procure Chemical Sup	
	1CN3320	Procure Cooling Water System (common 1&30MW)	9m 10/1/12		10m	ь	os	Procure Cooling Water	
	1CN3310	Procure He Storage and Sunniv System (common 1830)	9m 10/1/12		10m	q	OS	Procure He Storage a	
L	1CN3300	Procure He Purification System (common 1830MW)	9m 10/1/12		13m	8	05	Procure the Purificat.	
L	2CN3185	Install Pressurized Cooling Water System	3m 6/27/13		13m	8	. S	Install Pressurized	
	2CN3175	Install Male-up Water System	3m 6/27/13		13m	8	05	make-up Wate-	
	2CN1715	Install Purified Water Production System	3m 6/27/13		13m	6	OS	Install Purified Wat.	
	2CN1535	Install Helium Sampling System	3m 6/27/13	3 9/26/13	13m	40	\$0	Install Helium Sampl	
	1CN3560	Install Nitrogen Gas System (common 1&30MW)	3m 6/27/13		10m	4	0\$	Install Nirogen Gas	
	1CN3550	Install Compressed Air System (common 1&30MW)	3т 6/27/13		13m	8	0\$	histal Compressed A.	
	1CN3530	Install Waste Water Treatment (common 1&30MW)	3m 6/27/13		13m	ь	\$0	Install Waste Water	
	1CN3510	Install Cooling Water System (common 1&30MW)	3m 6/27/13		10m	ь	80	install Cooling Wate	
	1CN3500	Install He Storage and Supply System (common 18.30MW)	3m 6/27/13		10m	ક	. 0\$	install He Sprage a	
	1CN3540	Install Heat Trace System (common 1&30MW)	3т 9/26/13		10m	8	80	Install Heat Trace S	2
	1CN3520	Install Chemical Supply System (common 1&30MW)	зт 9/26/13	12/25/1	10m	ь	\$0	install Chemical Sup	ď
	1CN3490	Install He Purification System (common 1&30MW)	3m 9/26/13	12/25/1	10m	qo	80	Install He Purificat	
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	2CM1220	Turnover and Testing	3m 10/20/	3m 10/20/14 1/16/15			51.160.000		Turnover and Te
9	SIA2 CIEP	CTF1.4.2 CTF Programs and Procedures	2m 10/30/14 13/18/	TA DAY STA	U		5504 000		12/18/14, CTF1.4
	2CM1620	Proceeding Development for Operations & Maintenance	2m 10/20/	2m 10/20/14 12/18/14	0m0	1800h	\$252,000		Procedure Devek
	2CM1690	ES&H and Waste Program Development	2m 10/20/	2m 10/20/14 12/18/14		1800h	\$252,000		ES&H and Waste
ū	CTF1.4.3 CTF Training	vining	4m 11/19	fm 11/19/14 2/17/15	mp	4592h	\$647.88D		1 2/17/15, CTF
	2CM1590	Training Development for Operations	2m 11/19/	2m 11/19/14 1/16/15		2000h	\$280,000		Training Develo
120	2CM1610	Training of CTF Operators	1m 1/19/15	5 2/17/15	0m	2592h	\$362,880		Training of C
6	F144 Readir	CTF1.4.4 Readiniss Assessment	3m 2/17/1	21/11/12 4/11/15 ms	- Om	1940h	\$271.600		4/11/15
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	Actual Work		VIBUUDO N	_					(a) Delegation Production Inc.

CTF1.5   Readiness Alose sument and Corrective Actions   2m 2/17/15 4/17/15 5/15/15/15/15/15/15/15/15/15/15/15/15/15	### Troop	3	OI 022 00 04 01 02 09 04 07 1 02 09 04 07 1 02 09 04 07 1 02 09 04 07 1 02 09 04 07 1 02 09 04 07 1 02 09 04 07 1 02 09 04 07 1 02 09 04 04 09	2008   2011   2010   2010   2011	2013 2014 2010 2010 2010 2010 2010 2010 2010
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Remaining Level of Effort Remaining Work		Page	Page 9 of 9	TASK fitter, CTF - Exclude Working Milestones	nes.
Critical Remaining Work					

# **Appendix 2 – CTF Spending Plan**

CTF Spending Plan (excluding Operations)

WRC #	Tella	Budgeted Labor	Budgeted	EVOUG	EV2010	EV2044	EV2042	EV2013	FV2014	FY201E
2		Hours	Total Cost	20031	01071		- 14014	21071		
-	NGNP Component Test Facility (CTF)	616332h	\$388,750,943	\$15,287,592	\$13,699,838	\$12,075,566	\$238,492,331	\$97,504,160	\$7,213,759	\$4,477,697
-	CTF 1MW	29044h	\$26,259,227	\$2,948,578	\$2,969,003	\$396,648	\$7,332,763	\$12,593,273	\$18,962	
1.1.1	Conceptual Design - 1MW CTF	5948h	\$3,102,212	\$2,948,578	\$153,634					
1.1.2	Preliminary Design - 1MW CTF	9099	\$3,212,017		\$2,815,369	\$396,648				
1.1.3	Final Design - 1MW CTF	10446h	\$3,803,917				\$3,803,917			
1.1.4	Long Lead Procurement - 1MW CTF	4000h	\$3,755,000				\$3,523,682	\$231,318		
1.1.5	Construction - 1MW CTF	2044h	\$12,386,081				\$5,164	\$12,361,955	\$18,962	
1.2	CTF 30MW	248996h	\$239,736,761	\$6,777,098	\$6,467,944	\$6,913,899	\$149,949,940	\$70,627,880		
1.2.1	Conceptual Design - 30MW CTF	52616h	\$7,695,090	\$5,777,098	\$1,917,992					
1.2.2	Preliminary Design - 30MW CTF	78404h	\$11,463,851		\$4,549,952	\$6,913,899				
1.2.3	Final Design - 30MW CTF	112340h	\$16,492,225				\$16,492,225			
1.2.4	Long Lead Procurement - 30MW CTF	3900h	\$133,718,600				\$133,453,007	\$265,593		
1.2.5	Construction - 30MW CTF	1736h	\$70,366,995				\$4,708	\$70,362,287		
-3	CTF Building and BOP Systems	104074h	\$87,964,795	\$2,805,629	\$2,375,593	\$2,358,656	\$73,148,396	\$7,182,365	\$94,156	
1.3.1	Conceptual Design	25454h	\$3,409,219	\$2,805,629	\$603,590					
1.3.2	Preliminary Design	31050h	\$4,130,659		\$1,772,003	\$2,358,656				
1.3.3	Final Design	44442h	\$5,897,255				\$5,897,255			
1.3.4	Construction	3128h	\$74,527,662				\$67,251,141	\$7,182,365	\$94,156	
1.4	Commissioning - 1MW & 30MW CTF	22982h	\$3,257,480							\$3,257,480
1.4.1	Facility Turnover and Testing	8000h	\$1,160,000							\$1,160,000
1.4.2	CTF Programs and Procedures	3600h	\$504,000							\$504,000
1.4.3	CTF Training	4592h	\$642,880							\$642,880
1.4.4	Readiness Assessment	1940h	\$271,600							\$271,600
1.4.5	Operational Readiness Reviews	4850h	\$679,000							\$679,000
1.5	Project Management	211236h	\$31,532,680	\$3,756,287	\$1,887,298	\$2,406,363	\$8,061,232	\$7,100,641	\$7,100,641	\$1,220,217
1.5.1	Project Management Plan	624h	\$87,360	\$87,360						
1.5.2	Preliminary Schedule and Cost Estimates	2120h	\$296,800	\$89,730	\$207,070					
1.5.3	Baseline Schedule and Cost Estimates	6736h	\$958,040		\$40,633	\$917,407				
1.5.4	Reserved	등	\$0							
1.5.5	Project QA Program	760h	\$106,400	\$25,968	\$14,144	\$14,144	\$14,416	\$14,144	\$14,144	\$9,439
1.5.6	Reviews and Reports	1076h	\$208,640	\$58,000	\$150,640					
1.5.7	Project Support	77280h	\$11,881,800	\$3,495,228	\$1,474,811	\$1,474,811	\$1,503,173	\$1,474,811	\$1,474,811	\$984,153
1.5.8	Oversight of Construction	122640h	\$17,993,640				\$6,543,643	\$5,611,686	\$5,611,686	\$226,626

May 1, 2009

# **Appendix 3 – WBS Dictionary**

11.21   Internation   Security	1 NW	WBS	WBS Name	Hours	\$ Labor	\$ Material	\$ Equip.	\$ SubCon	ODCs (includes travel)	Total
11   INW	1 NW	1	NGNP Component Test Facility	616332	\$ 85 118 480	\$ 1,108 000	\$ 38.598 226	\$ 254.062.392	\$ 9,863,844	\$ 388.750 942
1.1.1   Conceptual Design - Turk VCTF   6968   \$ 933,727   \$   \$   \$   \$   \$   \$   \$   \$   \$	1.1   Conception   Design - HAW CFF   6048   \$ 353,720   \$	<u>'</u>								
11.11   IMT CFT Design Programmers   220   \$ 3,000   \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	1.1.1   11/2   Primary and Society Corporal NAM	manager and the second								
11.12   Primary and Secondary Logs 1MW	1.1.2   Primary and Secondary Loops HaW									
1.12   Proliminary Design - HWM CTF	1.2   Preliminary Design - TIMM CTF			5070	\$ 709,800	\$ -	\$ -	\$ 2,166,667	\$ 102,825	\$ 2,979,292
11.2.1   International Process Central May   Section	1.2.1   IMAN CFT Design Requirements	1.1.1.3	Instrument & Process Control 1MW	658	\$ 92,120	\$ -	\$ -	\$ -	\$ -	\$ 92,120
11.22   Primary and Secondary Loops IMW   5070   \$ 706.000   \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$	1.2.2 Priesty and Secondary Loops IMW								<del></del>	<del> </del>
13.23   Instrument & Process Control IMW   1316   \$ 194,240   \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$	1.2.2   Instrument & Process Control LWV			t	· · · · · · · · · · · · · · · · · · ·	<u> </u>			<del></del>	
13.5.1   Mark CTF Cosign Requirements	1.3.1   MAN CTF Design Requirements									
13.5.1   Mark CTF Cosign Requirements	1.3.1   MAN CTF Design Requirements	113	Final Design - 1MWt CTF	10446	\$ 1,462,440	\$ -	\$ -	\$ 2.166.667	\$ 174.810	\$ 3.803.917
11.13.2   Instrument A Process Control 10 S   10	1.3.2   Primary and Secondary Loops IMW   5070   \$ 709.800   \$ . \$ . \$ . \$ . \$ . \$ 174,810   \$ . \$ 3,051,275					<u> </u>			+ '	
1.1.4   Long Lead Procurement - IMW CTF	1.1   Long Lead Procurement - IMM CTF			5070		\$ -	\$ -	\$ 2,166,667	\$ 174,810	\$ 3,051,277
1.1.5   Construction - IMWA CTF	1.5   Construction - IMW CFF			5156	\$ 721,840	\$ -	\$ -	\$ -	\$ -	\$ 721,840
11.50   Construction - TMM CTF	1.5   Contraction - TIMM CTF	1.1.4	Long Lead Procurement - 1MWt CTF	4000	\$ 560,000	\$ -	\$ 3,195,000	\$ -	\$ -	<del></del>
1.1.5.2   Instrument and Process Control 1.8 30 M/M   248998   \$ 43,120   \$ 262,045   \$ 3,32,268   \$ 2,2890.00   \$ 7,044,366   \$ 239,739,749	1.5.2   Instrument and Process Centrol 1.8.30 M/M   248996   \$4.49.120   \$7.85.965   \$2.792.000   \$7.71.281.000   \$7.70.49.366   \$2.997.37, 76   \$7.30.900   \$7.70.49.366   \$2.997.37, 76   \$7.30.900   \$7.70.49.366   \$2.997.37, 76   \$7.30.900   \$7.70.49.366   \$7.30.900   \$7.70.900   \$7.70.49.366   \$7.30.900   \$7.70.9	1.1.5	Construction - 1MWt CTF	2044	\$ 286,160	\$ 262,045	\$ 5,322,868	\$ 6,515,008	\$ -	
12   30MW   248998   \$34,859,440   \$785,955   \$2,792,000   \$171,251,000   \$7,048,386   \$29,736,781     12.1   Conceptual Design - 30MW CTF   52016   \$7,386,240   \$   \$   \$   \$   \$   \$   \$   \$   \$	2   30MW   CFC   52696   \$ 34,859,440   \$ 785,955   \$ 25,782,000   \$ 171,251,000   \$ 7,044,366   \$ 239,736,76	1.1.5.1				<del>                                     </del>				
1.2.1   Conceptual Design - 30M/M CFF   52816   \$ .7396,240   \$ . \$ . \$ . \$ . \$ .228,800   \$ .7595,900	2.1   Conceptual Design - 30MWN CTF   52616 \$ 7.396.240 \$ \$ . \$ . \$ . \$ 328.850 \$ 7.0900.00 \$	1.1.5.2	Instrument and Process Control 1 & 30 MWt	308	\$ 43,120	\$ 262,045	\$ 3,332,868	\$ 2,886,008	\$ -	\$ 6,524,041
13.11   SOMMA Design Requirements	2.1.1   SMWM Design Requirements	1.2						_ <del>`</del>		
12.12   Primary/Secondary/Tertisty (Fel Loops   49280   \$ 6,059,200   \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$	2.12   Primary/Scondary/Terting y feat Loops   43290   \$ 6,059,200   \$	1.2.1								
12.12   Preliminary Design - 30M/M CTF   78404   \$10,978,560   \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$	2.1.2   Primary/Secondary/Terlary Test Loops   4.3280   \$ 0.099.200   \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$	1.2.1.1		680	\$ 95,200	\$ -	\$	<u> </u>	\$ 4,250	\$ 99,450
12.13   Instrument & Process Control 30MM CTF   78404   \$ 10.976.650   \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$	2.1.3   Instrument & Process Control 30M/M CTF	1.2.1.2		43280	\$ 6,059,200	\$	\$	\$ -	\$ <u>2</u> 70,500	\$ 6,329,700
12.21   30MW CFF Design Requirements   500   \$ 70,000   \$ . \$ . \$ . \$ . \$ . \$ . 3,061   \$ 73,061   \$ 12.22   Primary Secondary Tetriary Loops 30MW   11994   \$ 1,677,760   \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$	2.2.1   30MM CFF Design Requirements   500   \$ 7,000   \$ . \$ . \$ . \$ . \$ . 3,061   \$ 73,06   \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$					<del></del>				
12.22   Primary Secondary Tertiary Loops 30MW   1994   1,677.760   \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$	2.22   Primary Secondary Tertiary Loops 30MW   1994   \$1,677.760   \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$	1.2.2	Preliminary Design - 30MWt CTF							\$ 11,463,851
12.23   Instrument & Process Control 30MW   11984   \$ 1,677,760   \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$	2.2.3   Instrument & Process Control 30MW   11984   \$1,677,760   \$ \$ \$ \$ 764,625   \$1,694,922	1.2.2.1	30MWt CTF Design Requirements	500			\$ -			
12.3   Final Design - 30MW CTF   112340   \$ 15,727,600   \$	2.3   Final Design - 30MW CTF   112340   \$15,727,690   \$ - \$ - \$ - \$ - \$ 704,625   \$16,422   \$2.13.13   30MW CTF Design Requirements   500   \$70,000   \$ - \$ - \$ - \$ - \$ 3,125   \$73,125   \$3,321   \$13,948,000   \$ - \$ - \$ - \$ - \$ - \$ 3,125   \$73,125   \$13,948,000   \$ - \$ - \$ - \$ - \$ - \$ - \$ - \$ 16,600   \$13,938,000   \$103,948,000   \$ - \$ - \$ - \$ - \$ - \$ - \$ - \$ 116,500   \$13,938,000   \$103,948,000   \$ - \$ - \$ - \$ - \$ - \$ - \$ - \$ - \$ - \$								<del></del>	<del></del>
12.31   30M/M CFF Design Requirements   500   \$ 70,000   \$	2.3.1   30MW CTF Design Requirements   500   \$ 70,000   \$ . \$ . \$ . \$ . \$ . \$ 3,125   \$ 73,125   \$ 13,683,00     2.3.2   Primary Secondary Tertial Loops SolWW   93200   \$ 13,048,000   \$ . \$ . \$ . \$ . \$ . \$ . \$ 116,500   \$ 1,2726,10     2.4   Long Lead Procurement - 30MW   18640   \$ 2,609,600   \$ . \$ . \$ . \$ . \$ . \$ . \$ 116,500   \$ 2,726,10     2.5   Construction - 30MW   1736   \$ 243,040   \$ 785,955   \$ 2,992,000   \$ 66,346,000   \$ . \$ . \$ 70,366,981,00     2.5   Solwin Fest Loop Installation   1736   \$ 243,040   \$ 785,955   \$ 2,992,000   \$ 66,346,000   \$ . \$ . \$ 70,366,981,00     2.5   Solwin Fest Loop Installation   1736   \$ 243,040   \$ 785,955   \$ 2,992,000   \$ 66,346,000   \$ . \$ . \$ . \$ 765,955     2.5   Solwin Fest Loop Installation   1736   \$ 243,040   \$ 785,955   \$ 2,992,000   \$ 66,346,000   \$ . \$ . \$ . \$ . \$ . \$ 765,955     3.3   CTF Building and BOP Systems   104074   \$ 13,402,360   \$ 20,000   \$ 4,288,358   \$ 69,781,384   \$ 472,893   \$ 87,984,78     3.1   Conceptual Design   25454   \$ 3,271,560   \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ 137,659   \$ 3,402,301     3.1   Conceptual Design   25454   \$ 3,271,560   \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$	1.2.2.3	Instrument & Process Control 30MW	11984	\$ 1,677,760	\$	\$ -	\$ -	\$ 80,705	\$ 1,758,465
12.3.2   Primary Secondary Tertiary Loops 30MW   93200   \$ 13,040,000   \$   \$   \$   \$   \$   \$   \$   \$   \$	23.2   Primary Secondary Terliary Loops 30MW   93.00   \$ 13.048.000   \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$ . \$	1.2.3				<del></del>				
12.33   Instrument & Process Control 30MW   18640   \$ 2,609,600   \$ . \$ . \$ . \$ . \$ . \$ 116,500   \$ 2,726,100	23.3   Instrument & Process Control 30MW   18640   \$ 2,609,600   \$ . \$ . \$ . \$ . \$ . \$ . \$ 116,500   \$ 2,728,100								+	
12.5   Construction - 30MWR	2.5   Construction - 30MW					aprendia i i				
12.5   Construction - 30MW1	2.5   Construction - 30MW	1.2.4	Long Lead Procurement - 30MWt	3900	\$ 546,000	\$ -	\$ 22,800,000	\$ 104,905,000	\$ 5,467,600	1
12.5.1 30MW Test Loop Installation         1736         \$ 243,040         \$ \$ \$ 2,992,000         \$ 66,346,000         \$ \$ \$ 80,816,000           1.5.5.2 Instrument & Process Control 30MW         0         \$ 785,955         \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	2.5.1   30MWR Test Loop Installation   1736   \$ 243,040   \$ - \$ 2,992,000   \$ 66,346,000   \$ - \$ 69,581,04	105	Construction 20MIAA	1736	f 242 040	£ 705.055	e 2002000	e ee 24e 000	<u> </u>	
12.52   Instrument & Process Control 30MW   0   \$ - \$ 785,955 \$ - \$ - \$ - \$ 785,955 \$   \$ - \$ \$ 785,955 \$   \$ - \$ \$ 785,955 \$   \$ - \$ \$ 785,955 \$   \$ - \$ \$ 785,955 \$   \$ - \$ \$ 785,955 \$   \$   \$ 1.30 CTF Building and BOP Systems   104074   \$ 13,402,360 \$ 20,000 \$ 4,288,358 \$ 69,781,384 \$ 472,993 \$ 87,964,795 \$   \$ 13.1   Duilding and Utilities CD   14600 \$ 1,752,000 \$ - \$ - \$ - \$ - \$ 137,659 \$ 3,400,219 \$   \$ 3,402,130 \$   \$ 1,511,511,511   \$ 1,511,511,511   \$ 1,511,511,511,511,511,511,511,511,511,5	2.5.2   Instrument & Process Control 30MW   0   \$   \$   785,955 \$   \$   \$   \$   \$   \$   \$   \$   \$   \$								+ -	
13.1   Conceptual Design									+	
13.1   Conceptual Design		1.3	CTF Building and BOP Systems	104074	\$ 13.402.360	\$ 20.000	\$ 4.288.358	\$ 69,781,384	\$ 472,693	\$ 87.964.795
13.11   Building and Utilities CD	3.1.1   Building and Utilities CD	1.3.1	· · · · · · · · · · · · · · · · · · ·			·				
1.3.2 Preliminary Design	3.2   Preliminary Design   31050 \$ 3,993,000 \$ - \$ - \$ - \$   \$ 137,659 \$ 4,130,65	1.3.1.1		14600	\$ 1,752,000	\$ -	\$ -	\$ -	\$ 77,130	\$ 1,829,130
1.3.2.1 Building and Utilities PD	3.2.1   Building and Utilities PD	1.3.1.2	Support Systems CD	10854	\$ 1,519,560	\$ -	\$ -	\$ -	\$ 60,529	\$ 1,580,089
1.3.2   Support Systems PD	3.3.2   Support Systems PD	1.3.2	Preliminary Design	31050	\$ 3,993,000	\$ -	\$ -	\$ -	\$ 137,659	\$ 4,130,659
1.3.3 Final Design	3.3   Final Design									
1.3.3.1   Building and Utilities FD	3.3.1   Building and Utilities FD   26100   \$ 3,132,000   \$ - \$ - \$ - \$   \$ 110,000   \$ 3,242,00	1.3.2.2	Support Systems PD	13350	\$ 1,869,000	\$ -	\$ -	\$ -	\$ 60,529	\$ 1,929,529
1.3.3.2       Support Systems FD       18342       \$ 2,567,880       \$ -       \$ -       \$ -       \$ 87,375       \$ 2,655,255         1.3.4       Construction       3128       \$ 437,920       \$ 20,000       \$ 4,288,358       \$ 69,781,384       \$ -       \$ 74,527,662         1.3.4.1       Building Construction       2380       \$ 333,200       \$ -       \$ -       \$ 67,113,284       \$ -       \$ 67,446,484         1.3.4.2       Building Furnishings       440       \$ 61,600       \$ 20,000       \$ 508,358       \$ 14,000       \$ -       \$ 603,958         1.3.4.3       Support Systems       308       \$ 43,120       \$ -       \$ 3,780,000       \$ 2,654,100       \$ -       \$ 6,477,220         1.4       Commissioning - 1MWt & 30MWt CTF       22982       \$ 3,217,480       \$ 40,000       \$ -       \$ -       \$ -       \$ 3,257,480         1.4.1       Facility Turnover and Testing       8000       \$ 1,120,000       \$ 40,000       \$ -       \$ -       \$ -       \$ 1,160,000         1.4.2       CTF Programs and Procedures       3600       \$ 504,000       \$ -       \$ -       \$ -       \$ -       \$ 504,000         1.4.3       Readiness Assessment       1940       \$ 271,600       \$ -       \$	1.3.3.2   Support Systems FD	1.3.3				<del></del>				
1.3.4 Construction 3128 \$ 437,920 \$ 20,000 \$ 4,288,358 \$ 69,781,384 \$ - \$ 74,527,662	3.4   Construction   3128   \$437,920   \$20,000   \$4,288,358   \$69,781,384   \$ - \$74,527,66     3.4.1   Building Construction   2380   \$333,200   \$ - \$ - \$67,113,284   \$ - \$67,446,48     3.4.2   Building Furnishings   440   \$61,600   \$20,000   \$508,358   \$14,000   \$ - \$603,95     3.4.3   Support Systems   308   \$43,120   \$ - \$37,80,000   \$2,654,100   \$ - \$6,477,22     4   Commissioning - 1MWt & 30MWt CTF   22982   \$3,217,480   \$40,000   \$ - \$ - \$ - \$   \$3,780,000     4.1   Facility Tumover and Testing   8000   \$1,120,000   \$40,000   \$ - \$ - \$ - \$   \$1,600,00     4.2   CTF Programs and Procedures   3600   \$504,000   \$ - \$ - \$ - \$   \$- \$1,600,00     4.3   CTF Training   4592   \$642,880   \$ - \$ - \$ - \$ - \$   \$- \$642,88     4.4   Readiness Assessment   1940   \$271,600   \$ - \$ - \$ - \$ - \$   \$- \$   \$679,00     4.5   ORR   4850   \$679,000   \$ - \$ - \$ - \$ - \$   \$- \$   \$679,00     5.6   Project Management   Plan   624   \$87,360   \$ - \$ - \$ - \$   \$- \$   \$15,000   \$   \$1,944,640   \$31,532,68     5.1   Project Management   624   \$87,360   \$ - \$ - \$ - \$   \$- \$   \$- \$   \$296,800     5.2   Preliminary Schedule and Cost Estimates   2120   \$296,800   \$ - \$ - \$ - \$   \$- \$   \$- \$   \$- \$   \$- \$     5.5   Project QA Program   760   \$106,400   \$ - \$ - \$ - \$   \$- \$   \$- \$   \$- \$   \$- \$     5.5   Project Support   77280   \$10,810,000   \$ - \$ - \$ - \$   \$- \$   \$- \$   \$- \$     5.6   CTF Operations (not included in total)   82000   \$57,400,000   \$ - \$ - \$ - \$   \$- \$   \$- \$   \$- \$   \$- \$     5.7   Project Support   77280   \$10,810,000   \$ - \$ - \$ - \$   \$- \$   \$- \$   \$- \$     5.8   Oversight of Construction   122640   \$17,169,600   \$ - \$ - \$   \$ - \$   \$- \$   \$- \$   \$- \$   \$- \$     5.7   Project Support   77280   \$10,810,000   \$ - \$ - \$   \$ - \$   \$- \$   \$- \$   \$- \$     5.8   Oversight of Construction   122640   \$17,169,600   \$ - \$   \$ - \$   \$ - \$   \$- \$   \$- \$   \$- \$   \$- \$     5.8   Oversight of Construction   122640   \$17,169,600   \$ - \$   \$ - \$   \$- \$   \$- \$   \$- \$   \$- \$     5.7   Project Support   77280   \$10,810,000   \$ - \$   \$ - \$									
1.3.4.1   Building Construction	3.4.1   Building Construction   2380   \$ 333,200   \$ - \$ - \$ 67,113,284   \$ - \$ 67,446,48     3.4.2   Building Furnishings   440   \$ 61,600   \$ 20,000   \$ 508,358   \$ 14,000   \$ - \$ 603,95     3.4.3   Support Systems   308   \$ 43,120   \$ - \$ 3,780,000   \$ 2,654,100   \$ - \$ 6,477,22     4.4   Commissioning - 1MWt & 30MWt CTF   22982   \$ 3,217,480   \$ 40,000   \$ - \$ - \$ - \$ - \$ - \$ 3,257,48     4.1   Facility Turnover and Testing   8000   \$ 1,120,000   \$ 40,000   \$ - \$ - \$ - \$ - \$ - \$ 1,160,00     4.2   CTF Programs and Procedures   3600   \$ 504,000   \$ - \$ - \$ - \$ - \$ - \$ 504,00     4.3   CTF Training   4592   \$ 642,880   \$ - \$ - \$ - \$ - \$ - \$ 642,88     4.4   Readiness Assessment   1940   \$ 271,600   \$ - \$ - \$ - \$ - \$ - \$ - \$ 679,00     4.5   ORR   4850   \$ 679,000   \$ - \$ - \$ - \$ - \$ - \$ - \$ 679,00     5.5   Project Management Plan   624   \$ 87,360   \$ - \$ - \$ - \$ - \$ - \$ - \$ 296,800     5.5.1   Project Management Plan   624   \$ 87,360   \$ - \$ - \$ - \$ - \$ - \$ - \$ 296,800     5.5.2   Preliminary Schedule and Cost Estimates   6736   \$ 943,040   \$ - \$ - \$ - \$ - \$ - \$ - \$ - \$ 296,800     5.6   Reviews and Reports   1076   \$ 160,400   \$ - \$ - \$ - \$ - \$ - \$ 10,602,000     5.6   Reviews and Reports   1076   \$ 160,640   \$ - \$ - \$ - \$ - \$ - \$ 10,62,600     5.7   Project Support   77280   \$ 1,819,200   \$ - \$ - \$ - \$ - \$ - \$ 10,62,600     5.7   Project Support   77280   \$ 1,819,200   \$ - \$ - \$ - \$ - \$ - \$ 10,62,600     5.7   Project Support   77280   \$ 1,819,200   \$ - \$ - \$ - \$ - \$ - \$ 10,62,600     5.8   CTF Operations (not included in total)   82000   \$ 57,400,000   \$ - \$ - \$ - \$ - \$ - \$ 34,750,000   \$ 92,150,000     5.8   CTF Operations (not included in total)   82000   \$ 57,400,000   \$ - \$ - \$ - \$ - \$ - \$ 34,750,000   \$ 92,150,000     5.7   CTF Operations (not included in total)   82000   \$ 57,400,000   \$ - \$ - \$ - \$ - \$ - \$ - \$ 34,750,000   \$ 92,150,000     5.8   CTF Operations (not included in total)   82000   \$ 57,400,000   \$ - \$ - \$ - \$ - \$ - \$ 34,750,000   \$ 92,150,000   \$ 92,150,000   \$ 92,150,000   \$ 92,150,		Support Systems I D	10342	₩ £,507,000				01,375	
1.3.4.2   Building Furnishings	3.4.2   Building Furnishings	1.3.4								
1.3.4.3 Support Systems 308 \$ 43,120 \$ - \$ 3,780,000 \$ 2,654,100 \$ - \$ 6,477,220 \$ 1.4 Commissioning - 1MWt & 30MWt CTF 22982 \$ 3,217,480 \$ 40,000 \$ - \$ - \$ - \$ 3,257,480 \$ 1.4.1 Facility Turnover and Testing 8000 \$ 1,120,000 \$ 40,000 \$ - \$ - \$ - \$ 1,160,000 \$ 1.4.2 CTF Programs and Procedures 3600 \$ 504,000 \$ - \$ - \$ - \$ - \$ 504,000 \$ 1.4.3 CTF Training 4592 \$ 642,880 \$ - \$ - \$ - \$ - \$ 6,42,880 \$ 1.4.4 Readiness Assessment 1940 \$ 271,600 \$ - \$ - \$ - \$ - \$ - \$ 271,600 \$ 1.4.5 ORR 4850 \$ 679,000 \$ - \$ - \$ - \$ - \$ - \$ 679,000 \$ 1.4.5 Project Management 211236 \$ 29,573,040 \$ - \$ - \$ - \$ 15,000 \$ 1,944,640 \$ 31,532,680 \$ 1.5.1 Project Management Plan 624 \$ 87,360 \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ - \$ - \$ - \$ - \$ - \$ - \$ - \$ - \$ 296,800 \$ -	3.4.3   Support Systems   308   \$ 43,120   \$ - \$ 3,780,000   \$ 2,654,100   \$ - \$ 6,477,22     3.4.4   Commissioning - 1MWt & 30MWt CTF   22982   \$ 3,217,480   \$ 40,000   \$ - \$ - \$ - \$ - \$ 3,257,48     3.4.1   Facility Turnover and Testing   8000   \$ 1,120,000   \$ 40,000   \$ - \$ - \$ - \$ - \$ 5,160,00     3.4.2   CTF Programs and Procedures   3600   \$ 504,000   \$ - \$ - \$ - \$ - \$ - \$ 504,000     3.4.3   CTF Training   4592   \$ 642,880   \$ - \$ - \$ - \$ - \$ - \$ 642,88     3.4.4   Readiness Assessment   1940   \$ 271,600   \$ - \$ - \$ - \$ - \$ - \$ 271,600     3.5   ORR   4850   \$ 679,000   \$ - \$ - \$ - \$ - \$ - \$ 679,000     3.5   Project Management Plan   624   \$ 87,360   \$ - \$ - \$ - \$ - \$ - \$ 8,274,600     5.1   Project Management Plan   624   \$ 87,360   \$ - \$ - \$ - \$ - \$ - \$ 8,268,80     5.2   Preliminary Schedule and Cost Estimates   6240   \$ 296,800   \$ - \$ - \$ - \$ - \$ - \$ 8,268,80     5.3   Baseline Schedule and Cost Estimates   6736   \$ 943,040   \$ - \$ - \$ - \$ 15,000   \$ - \$ 958,040     5.5   Project QA Program   760   \$ 106,400   \$ - \$ - \$ - \$ - \$ 5,000   \$ 208,640     5.7   Project Support   77280   \$ 10,819,200   \$ - \$ - \$ - \$ - \$ 1,062,600   \$ 11,881,80     5.8   CTF Operations (not included in total)   82000   \$ 57,400,000   \$ - \$ - \$ - \$ - \$ - \$ 34,750,000   \$ 92,150,000     5.7   CTF Operations (not included in total)   82000   \$ 57,400,000   \$ - \$ - \$ - \$ - \$ - \$ 34,750,000   \$ 92,150,000     5.8   CTF Operations (not included in total)   82000   \$ 57,400,000   \$ - \$ - \$ - \$ - \$ - \$ 34,750,000   \$ 92,150,000     5.8   CTF Operations (not included in total)   82000   \$ 57,400,000   \$ - \$ - \$ - \$ - \$ - \$ 34,750,000   \$ 92,150,000     5.8   CTF Operations (not included in total)   82000   \$ 57,400,000   \$ - \$ - \$ - \$ - \$ - \$ 34,750,000   \$ 92,150,000     5.8   CTF Operations (not included in total)   82000   \$ 57,400,000   \$ - \$ - \$ - \$ - \$ - \$ 34,750,000   \$ 92,150,000     5.8   CTF Operations (not included in total)   82000   \$ 57,400,000   \$ - \$ - \$ - \$ - \$ - \$ 34,750,000   \$ 92,150,000     5.8   CTF Operati									
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1.4.2       CTF Programs and Procedures       3600       \$ 504,000       \$ -       \$ -       \$ -       \$ 504,000         1.4.3       CTF Training       4592       \$ 642,880       \$ -       \$ -       \$ -       \$ -       \$ 642,880         1.4.4       Readiness Assessment       1940       \$ 271,600       \$ -       \$ -       \$ -       \$ -       \$ 271,600         1.4.5       ORR       4850       \$ 679,000       \$ -       \$ -       \$ -       \$ -       \$ 679,000         1.5.1       Project Management       211236       \$ 29,573,040       \$ -       \$ -       \$ -       \$ -       \$ 679,000         1.5.1       Project Management Plan       624       \$ 87,360       \$ -       \$ -       \$ -       \$ -       \$ 87,360         1.5.2       Preliminary Schedule and Cost Estimates       2120       \$ 296,800       \$ -       \$ -       \$ -       \$ -       \$ 296,800         1.5.3       Baseline Schedule and Cost Estimates       6736       \$ 943,040       \$ -       \$ -       \$ -       \$ 296,800         1.5.4       Reserved       \$ -       \$ -       \$ -       \$ -       \$ -       \$ 296,800         1.5.5       Project QA Program       760 <td< td=""><td>  1.4.2   CTF Programs and Procedures   3600   \$ 504,000   \$ - \$ - \$ - \$ - \$ 504,000   \$ - \$   \$ - \$ - \$ 504,000   \$ - \$   \$ - \$ - \$ 504,000   \$ - \$   \$ - \$ - \$ 504,000   \$ - \$   \$ - \$ - \$ 504,000   \$ - \$   \$ - \$ - \$ 504,000   \$ - \$   \$ - \$ 504,000   \$ -</td><td>1.4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>	1.4.2   CTF Programs and Procedures   3600   \$ 504,000   \$ - \$ - \$ - \$ - \$ 504,000   \$ - \$   \$ - \$ - \$ 504,000   \$ - \$   \$ - \$ - \$ 504,000   \$ - \$   \$ - \$ - \$ 504,000   \$ - \$   \$ - \$ - \$ 504,000   \$ - \$   \$ - \$ - \$ 504,000   \$ - \$   \$ - \$ 504,000   \$ -	1.4								
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1.5.6     Reviews and Reports     1076     \$ 150,640     \$ -     \$ -     \$ 58,000     \$ 208,640       1.5.7     Project Support     77280     \$ 10,819,200     \$ -     \$ -     \$ -     \$ 1,062,600     \$ 11,881,800       1.5.8     Oversight of Construction     122640     \$ 17,169,600     \$ -     \$ -     \$ -     \$ 824,040     \$ 17,993,640       1.6     CTF Operations (not included in total)     82000     \$ 57,400,000     \$ -     \$ -     \$ -     \$ 34,750,000     \$ 92,150,000	.5.6       Reviews and Reports       1076       \$ 150,640       \$ - \$ - \$ - \$ 58,000       \$ 208,64         .5.7       Project Support       77280       \$ 10,819,200       \$ - \$ - \$ - \$ 1,062,600       \$ 11,881,80         .5.8       Oversight of Construction       122640       \$ 17,169,600       \$ - \$ - \$ - \$ 824,040       \$ 17,993,64         .6       CTF Operations (not included in total)       82000       \$ 57,400,000       \$ - \$ - \$ - \$ 34,750,000       \$ 92,150,000	1.5.5		760						
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1.6 CTF Operations (not included in total) 82000 \$ 57,400,000 \$ - \$ - \$ - \$ 34,750,000 \$ 92,150,000	.6 CTF Operations (not included in total) 82000 \$ 57,400,000 \$ - \$ - \$ - \$ 34,750,000 \$ 92,150,000									
		1.5.8	Oversight of Construction	122640	\$ 17,169,600	\$ -	\$ -	\$ -	\$ 824,040	\$ 17,993,640
Project Cost \$ 388.750.942	Project Cost \$ 388,750,94	1.6	CTF Operations (not included in total)	82000	\$ 57,400,000	\$ -	\$ -	\$ -	\$ 34,750,000	\$ 92,150,000
									Project Cost	\$ 388,750,942

WORK BREAKDOWN STRUCTURE DICTIONARY	1
WRS ELEMENT DEFINITION	

1. PROJECT TITLE/	PARTICIPANT	2. Date of Preparation
NGNP CTF / AREVA		2/12/2009
3. WBS Number	4. WBS Element Title	
1.1.1	Conceptual Design - 1MWt CTF	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

#### 8. Work Statement

Work to be done: Perform 1 MW CTF Conceptual Design by using the design developed during the Pre-Conceptual Design phase to further develop the design requirements and detail [Activity S0500]. The design information will include further developed system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. Equipment and component handling and installation requirements, instrumentation and control systems, and process and data acquisition software requirements will be further developed. Major equipment and support systems includes: Primary/Secondary Test Loops, First/Second Stage Electric Heater, Recuperator Heat Exchangers, High/Medium/Low Temperaturi Heat Exchangers, Circulators, Connecting Pipe/Duct; Control, Isolation, Check and Relief Valves; Helium Purification System, Helium Supply and Storage System, Cooling Water System, Compressed Air System, Electrical Power System, I&C and Data Acquisition, and Building and Building Services. Update the associated hardware / equipment cost estimate.

Key Assumptions: It is assumed that the conceptual design of the NGNP indirect steam cycle is developed to the point that the TDRM and test plans for the compact IHX are finalized and that there are no major changes to the CTF design requirements. It is assumed that the revised test conditions (temperature and pressure) will not exceed the design limits in the CTF Preconceptual Design report. It is assumed that the hazards associated with injecting chemicals and dust into the test sections designed for environmental testing of the compact IHX and Helium Purification System can be mitigated without major changes to the CTF Preconceptual Design. Travel costs assume \$1500/domestic trip, \$5000/international trip.

Risk Elements: Programmatic changes, such as a DOE decision to stop development of the NGNP indirect steam cycle, may eliminate the need for a 1 MW CTF test loop. AREVA and DOE are unable to resolve contract issues related to IP rights.

#### 9. Basis of Estimate

Methodology: Summarize estimates for lower tier WBS elements.

10. Estimate Detail

10. Estimate Detail  Description of work	Hours	Labor Cost	\$ Material	\$ Equip.	\$ SubCon	5 ODCs	Lvl.
		•					
WBS CTF 1.1.1.1 1MWt Design Requirements	220	\$30,800					-
WBS CTF 1.1.1.2 Primary and Secondary Loops 1MWt	5070	\$709,800			\$2,166,667		_
WBS CTF 1.1.1,3 Instrument & Process Control 1MWt	658	\$92,120					
Confidence Level How good is the basis of estimate	low 1	2	3	4	5 high confid	dence	

### WORK BREAKDOWN STRUCTURE DICTIONARY WBS ELEMENT DEFINITION

1. PROJECT TITLE		2. Date of Preparation 2/12/2009
3. WBS Number 1.1.1.1	4. WBS Element Title 1MWt CTF Design Requirements	2/12/2009
5. Index Line No.	6. Revision No. Rev. 0	7. Revision Date

#### 8. Work Statement

Work to be done: Update the design requirements developed during the Initial Conceptual Design Phase for the 1 MW CTF Primary and Secondary Test Loops [Activity 1CD1001] and support systems [Activity 1CD1150]. Provide traceability to revised TDRM test plan requirements and MW test loop qualification test requirements [Activity 1CD1011]. Define test section design and interface requirements.

Key Assumptions: This cost and schedule estimate is based on the TDRMs for the indirect heat transfer configuration, which uses an IHX and secondary helium heat transfer loop to a power conversion loop or hydrogen production process. It is assumed that the NGNP indirect steam cycle is developed to the point that the TDRM and IHX test plans can be finalized. It is assumed that the revised test plans do not require redesign of the test loop (e.g., heater vessel to keep the operating conditions (temperature, pressure, chemistry) within the design code limits for the materials identified in the CTF Preconceptual Design report. It is also assumed that the design of the IHX and Helium Purification test sections chemical and dust injection systems can meet DOE safety requirements and do not require significant changes to the CTF Conceptual Design. It is assumed that qualification testing of 30 MW test loop equipment does not require operating the 1 MW test loop outside of the operating range identified in the CTF PCDR.

Risk Elements: Changes to the NGNP mission and technology development plans could impact the CTF design requirements.

The CTF design requirements may be impacted by the technology development and qualification needs of the baseline configuration, which may not include an IHX. Work on the IHXs (compact one for the hydrogen production loop and tubular for the power conversion loop) may no longer be funded.

#### 9. Basis of Estimate

Methodology: Labor estimate for the conceptual design requirements is based on the level of effort preparing the PCDR requirements document.

10. Estimate Detail

		\$	\$	\$	\$	\$	Conf
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi.
Update the CTF System Requirements document		•					
Principal Engineer	200	\$28,000					4
Senior Engineer							1
Engineer							
Designer						<u></u>	
Administrative Professionals	20	\$2,800				ļ	4
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					<b>_</b>	<del> </del>	
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						<b>├</b>	-
					<b></b>	<del> </del>	┼
<del></del>			<del> </del>			<del> </del>	+
Confidence Level		L			<u> </u>	Ь	
How good is the basis of estimate	low 1	2	3	4	5 high conf	idence	

		AKDOWN STRUCTURE DICTIONARY BS ELEMENT DEFINITION	
	**	BS ELEMENT DEFINITION	
1. PROJECT TITLE/	PARTICIPANT		2. Date of Preparation
NGNP CTF / AREVA			2/12/2009
3. WBS Number	4. WBS Element Title		
1.1.1.2	Primary and Secondary Loops 1M	1W	
5. Index Line No.	6. Revision No.		7. Revision Date
	Rev. 0		
8. Work Statement			
Develop Design Descrip for Test Loop Configura	otion for Primary Loop, Develop Desig tions, Perform Heat/Mass Balance, D	ed; Develop Equipment Specifications, Develop Process in Description for Secondary Loop, Design Description for sevelop System Specification for Primary Loop, Develop emp Piping, Specifications for Low Temp Piping, Preliming	r Test Sections, Design Description System Specification for Secondary
	•	to acquire the design rights of the HELITE Loop from ARE odification of original design to include a second loop and	
and test sections can be identified in the CTF Pre	e designed. It is assumed that the final econceptual Design report, It is also as	oped to the point that TDRM and compact IHX test plans of ized test plans do not specify operating conditions or trans sumed that the design of the IHX and Helium Purification hout major changes to the CTF Preconceptual Design con-	sients that exceed the design limits System test sections chemical and

Risk Elements: Changes to the NGNP mission and technology development plans could impact the CTF design requirements and design.

#### 9. Basis of Estimate

Methodology: Use customary and standard engineering practices.

		\$	2	\$	\$	5	Con
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi
Principal Engineer	600	\$84,000					4
Senior Engineer	1670	\$233,800					4
Engineer	1670	\$233,800					4
Designer	750	\$105,000					4
Administrative Professionals	380	\$53,200					4
ravel						\$102,825	4
Sub-Contractor Cost (Helite Design)					\$2,166,667		4
Confidence Level How good is the basis of estimate	low 1	2	3	4	5 high confid	ence	

			STRUCTURE ENT DEFINITI		RY			
1. PROJECT TITLE						2. Date of 2/12/	Prepara /2009	tion
3. WBS Number	4. WBS Element Title	! 4 RA\A/						
1.1.1.3 5. Index Line No.	Instrument and Process Control  6. Revision No.	roi 1 Ivivv		···		7. Revis	ion Dat	e
8. Work Statement	Rev. 0							
Work to be done: Provide conceptual de	sign for temperature, pressure and vill need control and monitoring.	flow control and	monitoring for 1	MW test loop a	and test section	ns. This will also	include (	other
Key Assumptions: 1. Commercially availa	sign for computer and data collection  able instruments can be used and n  ure and flow instruments on the test	no R&D is requir	ed.	epivora ed Iliw	I hy the suppli	er of the test sec	tions.	
Risk Elements:	to find commercially available instru							
9. Basis of Estimat	e e customary and standard engin						···	
10. Estimate Detail				1 <b>- K</b>		<u> </u>		CONT
	scription of work	Hours	\$ Labor Cost	\$ Material	\$ Equip.	\$ SubCon	\$ ODCs	Con Lvi.
De	scription of work	Hours	\$ Labor Cost	1 ' 1	\$ Equip.	1 '		
De	scription of work 0, 1CD1780, CD2000	Hours	Labor Cost	1 ' 1	\$ Equip.	1 '		
De Task 1CD1750, 1CD176 Principal Engineer Senior Engineer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176 Principal Engineer Senior Engineer Engineer	scription of work 0, 1CD1780, CD2000	158	\$22,120	1 ' 1	\$ Equip.	1 '		Lvi.
De Task 1CD1750, 1CD176 Principal Engineer Senior Engineer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Fask 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Fask 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Fask 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Fask 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4
De Task 1CD1750, 1CD176  Principal Engineer Senior Engineer Engineer Designer	scription of work 0, 1CD1780, CD2000	158 200	\$22,120 \$28,000	1 ' 1	\$ Equip.	1 '		4 4

low 1

How good is the basis of estimate

2

3

5 high confidence

WORK BREAKDO	OWN STRUC'	TURE DICTION	ONARY
WBS E	LEMENT DE	FINITION	

1. PROJECT TITL	E/PARTICIPANT	2. Date of Preparation
NGNP CTF / ARE\	/A	2/12/2009
3. WBS Number	4. WBS Element Title	
1.1.2	Preliminary Design - 1MWt CTF	
5. Index Line No.	6. Revision No.	7. Revision Date
1111	Rev. 0	

#### 8. Work Statement

Work to be done: Perform 1 MW CTF Preliminary Design by using the design developed during the Conceptual Design phase to further develop the design requirements and detail [Activity S0510]. The design information will include component level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, validation of the hazards analysis, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the equipment specifications further developed. Equipment, component, component handling and installation requirements, instrumentation and control systems, and process and data acquisition software requirements will be refined. Major equipment and support systems includes: First/Second Stage Electric Heater, Recuperator Heat Exchangers, High/Medium/Low Temperature Heat Exchangers, Circulators, Connecting Pipe/Duct; Control, Isolation, Check and Relief Valves; Helium Purification System, Helium Supply and Storage System, Cooling Water System, Compressed Air System, Electrical Power System, I&C and Data Acquisition, and Building and Building Services. Update the associated hardware / equipment cost estimate.

Key Assumptions: AREVA SAS supplies the high temperature piping, circulator, and heater design and equipment, Revisions to NGNP TDRMs do not have a significant impact on CTF design requirements.

Risk Elements: Negotiation of mutually acceptable terms and conditions between DOE and AREVA SAS for single source equipment.

9.	Bas	is	of	Es	tim	ate
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Methodology: Summarize estimates for lower tier WBS elements.

10.	<b>Estimate</b>	Detail

How good is the basis of estimate

		\$	\$	\$	60	6 000-	Con
Description of work	Hours	Labor Cost	Material	Equip.	\$ SubCon	\$ ODCs	Lv
WBS CTF 1.1.2.1 1MWt CTF Design Requirements	220	\$30,800					
WBS CTF 1.1.2.2 Primary & Secondary Loops 1MWt	5070	\$709,800			\$2,166,667		
WBS CTF 1.1.2.3 Instrument & Process Control 1MWt	1316	\$184,240					
							-

low 1

2

5 high confidence

# WORK BREAKDOWN STRUCTURE DICTIONARY WBS ELEMENT DEFINITION 1. PROJECT TITLE/PARTICIPANT NGNP CTF / AREVA 3. WBS Number 1.1.2.1 1.1.2.1 1.1.2.1 1.1.2.1 5. Index Line No. 6. Revision No. Rev. 0 1.1.2.1 1.1.2

#### 8. Work Statement

Work to be done: Update the design requirements developed during the Conceptual Design Phase for the 1 MW CTF Primary and Secondary Test Loops and support systems. Update requirements based on revised TDRM test plan requirements and 1 MW test loop qualification test requirements. Update test mock-up interface requirements.

Key Assumptions: This cost and schedule estimate is based on the TDRMs for the indirect heat transfer configuration, which uses an IHX and secondary helium heat transfer loop to a power conversion loop or hydrogen production process. It is assumed that the NGNP indirect steam cycle is developed to the point that TDRM and test plans can be finalized and the critical SSCs are defined well enough to design the test mock-ups and test sections. It is assumed that the revised test plans for the compact IHX do not require redesign of the test loop (e.g., heater vessel) to keep the operating conditions (temperature, pressure, chemistry) within the design code limits for the materials identified in the CTF Preconceptual Design report. It is also assumed that the design of the test sections which will inject chemicals and dust for environmental testing of the compact IHX and Helium Purification System can meet DOE safety requirements without major changes to the CTF Conceptual Design.

Risk Elements: Changes to the NGNP mission and technology development plans could impact the CTF design requirements.

The NGNP baseline reactor heat transfer loop configuration is subject to change. The design of the CTF may be impacted by the technology development and qualification needs of the baseline configuration, which may not include an IHX or secondary helium heat transfer loop. The compact IHX is being developed to provide high temperature heat to the hydrogen process as part of the nuclear hydrogen initiative. The NGNP project may defer work supporting the hydrogen initiative and focus on a lower temperature reactor that requires less R&D.

#### 9. Basis of Estimate

**Methodology**: Labor estimate for the preliminary design requirements is based on the level of effort preparing the PCDR requirements document.

#### 10. Estimate Detail

		\$	\$	\$		l	Con
Description of work	Hours	Labor Cost	Material	Equip.	\$ SubCon	\$ ODCs	Lv
pdate CTF systems requirements document					<b></b>		
Principal Engineer	200	\$28,000					4
Senior Engineer							ļ
Engineer							
Designer							L
Administrative Professionals	20	\$2,800					4
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Confidence Level		<u> </u>				<u> </u>	L

1. PROJECT TITLE/I	2. Date of Preparation 2/12/2009	
	4. WBS Element Title Primary and Secondary Loops 1MWt	
5. Index Line No.	6. Revision No. Rev. 0	7. Revision Date

#### 8. Work Statement

Work to be done: The following activities will be accomplished; Perform Industrial Safety Assessment for HT Enclosure, Design High Temp Enclosure, Develop Equipment Design, Update/Maintain Process Flow Diagram, Update/Maintain P&IDs, Update/Maintain Design Description for Primary Loop, Update/Maintain Design Description for Secondary Loop, Update/Maintain Design Description for Test Sections, Update/Maintain Design Description for Test Loop Configuration, Update/Maintain System Specification for Primary Loop, Update/Maintain System Specification for Transients, Prepare Drawings for Primary Loop Piping, Prepare Drawings for Secondary Loop Piping, Prepare Drawings for Primary Loop Electrical, Prepare Drawings for Secondary Loop Electrical

The \$2.16M subcontract cost represents 1/3 of the \$6.5M cost to acquire the design rights of the HELITE Loop from AREVA SAS. The \$709,800 labor costs includes updating to U.S. codes & standards, and modification of original design to include a second loop and provide multiple, parallel test capabilities.

Key Assumptions: The NGNP indirect steam cycle is developed to the point that TDRM and compact IHX test plans can be finalized and test mock-ups and test sections can be designed. It is assumed that the finalized test plans do not specify operating conditions or transients that exceed the design limits identified in the CTF Preconceptual Design report. It is also assumed that the design of the IHX and Helium Purification System test sections chemical and dust injection systems can meet DOE safety requirements without major changes to the CTF Preconceptual Design concept.

Risk Elements: Changes to the NGNP mission and technology development plans could impact the CTF design requirements and design.

#### 9. Basis of Estimate

Methodology: Use customary and standard engineering practices.

		\$	2	2	- 5	\$	Cont
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi.
Delegical Coninces	600	¢94,000					4
Principal Engineer	600	\$84,000					
Senior Engineer	1670	\$233,800					4
Engineer	1670	\$233,800					4
Designer	750	\$105,000					4
Administrative Professionals	380	\$53,200					4
Travel						\$120,510	4
Sub-Contractor Cost (Helite Design)					\$2,166,667		4
Confidence Level	1						
How good is the basis of estimate	low 1	2	3	4	5 high conf	idence	

	WORK E	REAKDOWN: WBS ELEME	STRUCTURE ENT DEFINITI		RY			
						7 2 3-46		-1
1. PROJECT TITLE						2. Date of	Prepara /2009	tion
NGNP CTF / AREVA	4. WBS Element Title					21:2	/2009	
3. <b>WBS N</b> umber 1.1.2.3	Instrument and Process Co	ntral 1MWt				]		
5. Index Line No.	6. Revision No.	THE THEFT				7. Revis	sion Dat	<u>-</u>
2. HIUGA EIIIO RO.	Rev. 0							
8. Work Statement								
Work to be done:	<del></del>							
	sign for temperature, pressure ar vill need control and monitoring.	nd flow control and	monitoring for 1	MW test loop a	and test sectio	ns. This will also	o include (	other
Key Assumptions: 1. Commercially availa 2. Temperature, press Risk Elements:	sign for computer and data collect able instruments can be used and sure and flow instruments on the of ind commercially available ins	d no R&D is requir test sections are n	ed. ot provided. The			plier of the test s	ections.	
•	<u>-</u>	-	·	_				
9. Basis of Estimate	Δ	<del></del>			<del></del>	<del></del>		
10. Estimate Detail								
10. ESUITIALE DELAII			\$	\$	\$	<b></b>	<b>T</b> \$	Con
<b>D</b> -								
De	scription of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi
Task 1PD2310, 1PD2320		Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi
		Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi
	), 1PD2330, 1PD2340	Hours 300	\$42,000	Material	Equip.	SubCon	ODCs	Lvi 4
Task 1PD2310, 1PD2320	), 1PD2330, 1PD2340	300 316	•	Material	Equip.	SubCon	ODCs	
Task 1PD2310, 1PD2320 Principal Engineer	), 1PD2330, 1PD2340	300	\$42,000	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer  Senior Engineer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer  Senior Engineer  Engineer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
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Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
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Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Task 1PD2310, 1PD2320  Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4
Principal Engineer Senior Engineer Engineer Designer	), 1PD2330, 1PD2340	300 316	\$42,000 \$44,240	Material	Equip.	SubCon	ODCs	4

<b>WORK BREAKDOWN S</b>	TRUCTURE DICTIONARY
WRS FI FMF	NT DEFINITION

1. PROJECT TITLE/	PARTICIPANT	2. Date of Preparation
NGNP CTF / AREVA		2/12/2009
3. WBS Number	4. WBS Element Title	
1.1.3	Final Design - 1MWt CTF	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

Work to be done: Perform 1 MW CTF Final Design by using the design developed during the Preliminary Design phase to finalize and approve the design requirements and documents [Activity S0520]. The design information will include component level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts. The technical and functional requirements for performance test (e.g., flow induced vibration, materials performance, and seals leak rates) instrumentation will be finalized. The equipment/component specifications will be finalized to establish the procurement requirements. Building, component, and equipment handling and installation requirements will be finalized. The instrumentation and control systems design and process and data acquisition software will be finalized and approved. Major equipment and support systems includes: First/Second Stage Electric Heater, Recuperator Heat Exchangers, High/Medium/Low Temperature Heat Exchangers, Circulators, Connecting Pipe/Duct; Control, Isolation, Check and Relief Valves; Helium Purification System, Helium Supply and Storage System, Cooling Water System, Compressed Air System, Electrical Power System, I&C and Data Acquisition, and Building and Building Services. Update the associated hardware / equipment cost estimate.

Key Assumptions: The CTF was designed to support the development of a high temperature indirect steam cycle NGNP which supports the national nuclear hydrogen initiative. The CTF test loops are designed with flexibility to test critical components of other NGNP heat transfer loop configurations, including a lower temperature NGNP. It is assumed that future revisions to the NGNP TDRMs and test plans, which may include heat transfer configurations that do not use an IHX, do not have a significant impact on CTF design requirements.

Risk Elements: Programmatic changes to the NGNP mission plan, The baseline NGNP configuration is under review, The NGNP R&D needs and test requirements are subject to change and could change the CTF design requirements and impact the design, Development and testing of the IHX may no longer be funded.

9. Basis of Estimat	<ol><li>Bas</li></ol>	sis o	f Est	imate
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Methodology: Summarize estimates for lower tier WBS elements.

10. Estimate Detail

		2	\$	\$			Cont
Description of work	Hours	Labor Cost	Material	Equip.	\$ SubCon	\$ ODCs	Lvi.
NBS CTF 1.1.3.1 1MWt CTF Design Requirements	220	\$30,800					
WBS CTF 1.1.3.2 Primary & Secondary Loops 1MW	5070	\$709,800			\$2,166,667		
WBS CTF 1.1.3.3 Instrument & Process Control 1MW	5156	\$721,840					
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Confidence Level							

Confidence Level

How good is the basis of estimate low 1 2 3 4 5 high confidence

1.1.3.1 1MN  5. Index Line No. 6. I Rev  8. Work Statement  Work to be done: Update to the state of the state	WBS Element Title IWt CTF Design Requirement Revision No. Iw. 0  the design requirements develops terms. Update requirements that the NGNP indirect stee the summed that the NGNP indirect stee the summed that would require operate of the NGNP mission and technology the NGNP mission and technology that the NGNP mission and technology the NGNP mission and technology that the NGNP mission and technology the NGNP mission and technology the NGNP mission and technology that the NGNP mission and technology the NG	reloped during its based on re- inferments.  earn cycle comp and finalize the strain of the heater attion System te logy developm	evised TDRM te ceptual design is he design require above the tempe est section chemic ent plans could in	developed to the ments for the 11 prature limits ideal and dust inject the CTF of the CT	ements and 3 ne point that NC HX test section entified in the C action systems design requiren	7. Rev  TW CTF Primar  O MW test loop  GNP TDRM and I  It is assumed it  TF Preconceptureet DOE safety  ments.	ision Date  y and Seco o qualificati  IHX test planat the final nal Design re y requireme	ondangion ons and iHX teleport. It
3. WBS Number 1.1.3.1 1MN 5. Index Line No. 6. I Rev 8. Work Statement Work to be done: Update t Test Loops and support sy test requirements. Update Key Assumptions: It is assu the design of the IHX is comp plans do not include test conc also assumed that the design Risk Elements: Changes to  9. Basis of Estimate Methodology: Labor esti  10. Estimate Detail  Descrip Update CTF systems requirem Principal Engineer Senior Engineer Engineer Designer	the design requirements developed in the design requirements developed in the design requirements developed in the design requirements developed in the design requirements at the test mock-up interface requirements at the NGNP indirect steep lette enough to order a mock-up inditions that would require operation of the IHX and Helium Purification the NGNP mission and technological timate for the final design requirements for the final design requirements document	reloped during is based on residents. It is based on residents. It is a search of the	ceptual design is the design require rabove the tempe sist section chemic ent plans could in based on the le	developed to the ments for the II reature limits ideal and dust injenpact the CTF of the II revel of effort p	ements and 3 ne point that NO HX test section entified in the C ection systems design requiren reparing the E	7. Rev  W CTF Primar  W W test loop  GNP TDRM and I  It is assumed th  TF Preconceptu  meet DOE safety  nents.  PCDR requirem	ry and Second qualification of qualifica	ondarion  ins and iHX te eport. I instants.
1.1.3.1 1MN  5. Index Line No. 6. I Rev.  8. Work Statement Work to be done: Update t Test Loops and support sy test requirements. Update t Key Assumptions: It is assumed that the design of the IHX is complans do not include test concalso assumed that the design Risk Elements: Changes to  9. Basis of Estimate  Methodology: Labor estimate  10. Estimate Detail  Descrip Update CTF systems requirem Principal Engineer Senior Engineer Engineer Designer	the design requirements developed in the design requirements developed in the design requirements developed in the design requirements developed in the design requirements at the test mock-up interface requirements at the NGNP indirect steep lette enough to order a mock-up inditions that would require operation of the IHX and Helium Purification the NGNP mission and technological timate for the final design requirements for the final design requirements document	reloped during is based on residents. It is based on residents. It is a search of the	ceptual design is the design require rabove the tempe sist section chemic ent plans could in based on the le	developed to the ments for the II reature limits ideal and dust injenpact the CTF of the II revel of effort p	ements and 3 ne point that NO HX test section entified in the C ection systems design requiren reparing the E	IW CTF Primar 0 MW test loop GNP TDRM and I . It is assumed th CTF Preconceptu meet DOE safety ments.  PCDR requirem	ry and Second qualification of the final part the f	ondarion  ins and iHX te eport. I
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Principal Engineer Senior Engineer Engineer Designer		200	\$28,000					4
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		AKDOWN STRUCTURE DICTIONARY BS ELEMENT DEFINITION	
1. PROJECT TITLE/ NGNP CTF / AREVA			2. Date of Preparation 2/12/2009
3. WBS Number 1.1.3.2	4. WBS Element Title Primary and Secondary Loops 1M	/W	
5. Index Line No.	6. Revision No. Rev. 0		7. Revision Date

Work to be done: The following activities will be accomplished; Finalize Equipment Specifications. Finalize P&IDs. Finalize Design Description for Primary Loop, Finalize Design Description for Secondary Loop, Finalize Design Description for Test Sections, Finalize Design Description for Test Loop Configurations, Develop Construction Specification for Primary Loop, Develop Construction Specification for Secondary Loop, Complete Piping Drawings for Primary Loop, Complete Piping Drawings Secondary Loop, Complete Electrical Drawings for Primary Loop, Complete Electrical Drawings Secondary Loop

The \$2.16M subcontract cost represents 1/3 of the \$6.5M cost to acquire the design rights of the HELITE Loop from AREVA SAS. The \$709,800 labor cost includes updating to U.S. codes & standards, and modification of original design to include a second loop and provide multiple, parallel test capabilities.

Key Assumptions: The NGNP indirect steam cycle is developed to the point that TDRM and compact IHX test plans can be finalized and test mock-ups and test sections can be designed. It is assumed that the finalized test plans do not specify operating conditions or transients that exceed the design limits identified in the CTF Preconceptual Design report. It is also assumed that the design of the IHX and Helium Purification System test sections chemical and dust injection systems can meet DOE safety requirements without major changes to the CTF Preconceptual Design concept.

Risk Elements: Changes to the NGNP mission and technology development plans could impact the CTF design requirements and design.

#### 9. Basis of Estimate

Methodology: Use customary and standard engineering practices.

How good is the basis of estimate

		\$	2	- 5	- \$	2	Con
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	LvI
Dringing Engineer	600	\$84,000					4
Principal Engineer							_
Senior Engineer	1670	\$233,800					4
Engineer	1670	\$233,800		_			4
Designer	750	\$105,000					4
Administrative Professionals	380	\$53,200					4
Travel						\$174,810	3
Sub-Contractor Cost (Helite Design)					\$2,166,667		4
Confidence Level							

12 of 60

low 1

4 5 high confidence

	WORK BREAKDOWN STRUCTURE DICTIONARY WBS ELEMENT DEFINITION					
1. PROJECT TITLE/			2. Date of Preparation 2/12/2009			
3. WBS Number 1.1.3.3	4. WBS Element Title Instrument and Process Contr	rol 1MW				
5. Index Line No.	6. Revision No. Rev. 0		7. Revision Date			
8. Work Statement						
•	temperature, pressure and flow co	entrol and monitoring for 1 MW test loop and test sections. This	s will also include other loop			
Provide final design for Key Assumptions:	computer and data collection and s	storage system.				

- 1. Commercially available instruments can be used and no R&D is required.
- 2. Temperature, pressure and flow instruments on the test sections are not provided. They will be provided by the supplier of the test sections.

We may not be able to find commercially available instruments for high temperature helium gas application.

9. Basis of Esti	mate		
Methodology:	Use customary and standard engineer	ering practices.	

		\$	2	\$	- \$	\$	Coi
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	L
						-	_
Principal Engineer	956	\$133,840					4
Senior Engineer	1200	\$168,000 \$420,000					-
Engineer	3000	\$420,000					1
Designer							
Administrative Professionals				-			
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1. PROJECT TITLE/	PARTICIPANT		2. Date of Preparation
NGNP CTF / AREVA			2/12/2009
	4. WBS Element Title		
1.1.4	Long Lead Procurement - 1MWt C	CTF	
5. Index Line No.	6. Revision No.		7. Revision Date
	Rev. 0		

#### 8. Work Statement

Work to be done: In order to meet the CTF schedule, equipment with long lead times for delivery must be identified and procured during the 1MW Conceptual Design Phase. This activity will include the development of the procurement specifications and procurement packages, evaluation and approval of suppliers, obtaining BEA and DOE approval, and award of the contracts. The items that have been identified as long lead items for the 1MW CTF include the circulators, hot gas piping, IHX heat exchanger, and electrical transformers rated 1 MVA or higher, Computer & Data Acquisition System, PI system and Simulator

**Key Assumptions:** Funding for long lead procurements will be available during the Conceptual Design Phase. Programmatic changes and revisions to the NGNP TDRMs and test plans do not have a significant impact on the specifications for the long lead procurement items.

Risk Elements: Funding for long lead procurements is not available when needed. Programmatic changes may make the long lead items obsolete.

#### 9. Basis of Estimate

Methodology: Estimate based on experience from previous projects and preliminary cost information from potential suppliers.

#### 10. Estimate Detail

		\$	\$	\$			Cont
Description of work	Hours	Labor Cost	Material	Equip.	\$ SubCon	\$ ODCs	LvI.
Procurement of Long Lead Items							
Principal Engineer	400	\$56,000					3
Senior Engineer	800	\$112,000					3
Engineer	1200	\$168,000					3
Designer							
Project Manager							
Quality Assurance	100	\$14,000					3
Administrative Professionals							
Project Controls							
Records/Document Management	200	\$28,000					3
ES&H	300	\$42,000					3
Procurement	1000	\$140,000					3
1 MWt Loop Equipment Costs (2008 USD)							
Primary Gas Circulator				\$500,000			4
Secondary Gas Circulator				\$500,000			4
First Stage Heater				\$700,000			4
Second Stage Heater				\$500,000			4
High Temp HX (Qty-2)				\$200,000			4
Low Temp HX (Qty-2)				\$50,000			4
Medium Temp HX				\$50,000			4
Recuperator (Qty-2)				\$100,000			4
Valves (primary & secondary loops)				\$300,000			4
Piping (primary & secondary loops)				\$80,000			4
Electrical Transformers rated 1MVA or higher				\$215,000			4

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NGNP CTF / AREVA							2/2009	Oli
3. WBS Number	4. WBS Element Title			****				$\overline{}$
1.1.5	Construct - 1MWt CTF							
5. Index Line No.	6. Revision No.					7. Revi	sion Date	1
0 10/ 1 0/ 1	Rev. 0	<u> </u>						
8. Work Statement	velop the procurement packages, e	voluato or	ad approve the	suppliers obt	ain REA and I	DOE approval	and awar	1 the
	the services of the constructor(s), to							
	os and Instrumentation and Control		ne equipment, t	zomponems,	and materials	to install 1 lviv	rilliary	an iu
Coornadiy Tool 200p	yo and monamentation and commen	Cyclomo.						
Key Assumptions:								
Risk Elements:								
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9. Basis of Estimate		Calamante			·			
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10. Estimate Detail								
To. Estimate Detail		-	\$	\$	\$			Cont.
Des	scription of work	Hours	Labor Cost	Material	Equip.	\$ SubCon	\$ ODCs	LvI.
1.1.5.1 1MWt Test Loop		1736	\$243,040	\$0	\$1,990,000	\$3,629,000		
1.1.5.2 Instrumentation	and Process Control	308	\$43,120	\$262,045	\$3,332,868	\$2,886,008	\$0	ļ
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Confidence Level How good is the basis of	of estimate	iow 1	2	3	4	5 high confi	dence	

1. PROJECT TITLE/F	PARTICIPANT	2. Date of Preparation
NGNP CTF / AREVA		2/12/2009
3. WBS Number	4. WBS Element Title	
1.1.5.1	1MWt Test Loop Installation	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

#### 8. Work Statement

Work to be done: Procure and install the equipment, piping, and electrical power for the 1 MW Primary and Secondary Test Loops.

Activities: procure Primary Loop process equipment and piping; procure Secondary Loop process equipment and piping; procure Test Section process equipment and piping; procure Primary Loop electrical power mat'l; procure Secondary Loop electrical power mat'l; procure Test Section electrical power mat'l.

Activities: install Primary Loop process equipment and piping; install Secondary Loop process equipment and piping; install Test Section process equipment and piping; install electrical power for Primary Loop; install electrical power for Secondary Loop.

Key Assumptions: It is assumed that programmatic changes and changes to the NGNP baseline do not have a significant impact on the NGNP TDRMs and test plans, CTF design requirements, or equipment specifications. Funding is assumed to be available as needed to support the schedule. Major Equipment is provided by the project.

Risk Elements: NGNP mission needs, priorities, and funding are revised annually.

Methodology: Estimate based on experience from previous projects.

		\$	\$	\$			Con
Description of work	Hours	Labor Cost	Material	Equip.	\$ SubCon	\$ ODCs	Lvi
Procurement of 1 MWt Test Loop Constructors							
Principal Engineer	80	\$11,200					4
Senior Engineer	80	\$11,200					4
Engineer	688	\$96,320					4
Designer							
Project Manager							
Quality Assurance	40	\$5,600					4
Administrative Professionals							
Project Controls							
Records/Document Management	80	\$11,200					4
ES&H	80	\$11,200					4
Procurement	688	\$96,320					4
Major Equipment Excluding Long Lead Equipment				\$1,990,000			4
Installation of 1 MWt Test Loop Items							
Mechanical Constructor					\$2,360,000		4
Electrical Constructor					\$1,269,000		4

1. PROJECT TITLE/	PARTICIPANT	2. Date of Preparation
NGNP CTF / AREVA		2/12/2009
3. WBS Number	4. WBS Element Title	
1.1.5.2	Instrument and Process Control 1 & 30 MN	<b>∧</b> t
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

#### 8. Work Statement

#### Work to be done:

Procure materials and contractor to install the computer and data collection and storage system, temperature, pressure and flow control and monitoring for the 1 and 30 MW test loop and test sections. This will also include other loop parameters that will need control and monitoring.

#### Key Assumptions:

- 1. Commercially available instruments can be used and no R&D is required.
- 2. Temperature, pressure and flow instruments on the test sections is not provided. They will be provided by the supplier of the test sections.
- 3. Major Equipment Provided by the Project.

#### Risk Elements:

We may not be able to find commercially available instruments for high temperature helium gas application.

Process temperature will need to be reduced to the levels acceptable by the instruments proposed.

#### 9. Basis of Estimate

Methodology: Estimates based on RS Means, experience from previous projects and preliminary cost information from potential suppliers.

		\$	\$	\$	\$	\$	Con
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi
Procurement of 1 & 30 MWt I&C Installer		,					
Principal Engineer	20	\$2,800					4
Senior Engineer	40	\$5,600			·		4
Engineer	100	\$14,000					4
Designer							
Project Manager							
Quality Assurance	16	\$2,240					4
Administrative Professionals							
Project Controls							
Records/Document Management	16	\$2,240					4
ES&H	16	\$2,240					4
Procurement	100	\$14,000					4
MATERIAL							<b>—</b>
Temperature elements			\$38,625				3
Pressure transmitters			\$73,750				3
Flow elements			\$149,670		-		3
			<b>V</b> 1.10,010				Ĭ
Computer & Data Collection System (Shared)							
T3000 DCS Equipment & Engineering				\$2,260,980			4
PI System for 3000 IO Points				\$371,888			4
Simulator		:		\$700,000			4
I&C Installer					\$2,886,008		4
							Ė
Confidence Level							<u> </u>

1. PROJECT TITLE	PARTICIPANT	2. Date of Preparation
NGNP CTF / MHI		2/12/2009
3. WBS Number	4. WBS Element Title	
1.2.1	Conceptual Design - 30MWt CTF	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

#### 8. Work Statement

Work to be done: Perform 30 MWt CTF Conceptual Design by using the design developed during the Pre-Conceptual Design phase to further develop the design requirements and detail. The design information will include updated system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. The equipment and component handling and installation requirements, instrumentation and control systems, and process and data acquisition software requirements will be further developed. Major equipment includes: Primary/Secondary/Tertiary Test Loops, First/Second Stage Electric Heaters; High/Low Pressure Heat Exchangers, Hot Gas Mixing Tank, Primary/Secondary Hot Gas Ducts; Water Coolers; Circulators; Control, Isolation, Check and Relief Valves; Nitrogen Supply System, Purified Water System, Make Up Water System, Chemical Supply Systems, Helium Purification System, Helium Supply and Storage System, Cooling Water System, Compressed Air System, Electrical Power System, I&C and Data Acquisition, and Building and Building Services.

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Pre-Conceptual Design Phase are filled into the table. Material price is as of December 2008 and any escalation is not taken into account. Man-hour cost is as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Pre-Conceptual Design Phase. The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

		5	5	5	5	2	Cont
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	LvI.
Task #1		2.5					
Conceptual Design							
1.2.1.1 30MWt Design Requirements	680	\$95,200				\$4,250	
1.2.1.2 30MWt Loop CD	43280	\$6,059,200				\$270,500	
1.2.1.3 Instrument & Process Control 30MWt CD	8656	\$1,211,840				\$54,100	
Confidence Level How good is the basis of estimate	low 1	2	3	4	5 high conf	idence	

1. PROJECT TITLE	/PARTICIPANT	2. Date of Preparation 2/12/2009
3. WBS Number 1.2.1.1	4. WBS Element Title 30MWt CTF Design Requirements	
5. Index Line No.	6. Revision No. Rev. 0	7. Revision Date

#### 8. Work Statement

Work to be done: Further develop and update the 30 MWt CTF Design requirements for the Primary/Secondary/Tertiary Test Loops and support systems that were developed during the Pre-Conceptual Design phase. Also as a part of this activity there is an interface with the TDRM validation to confirm the assumptions made for the testing to be performed at the CTF are still valid or to make adjustments in the CTF design.

**Key Assumptions:** 

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Pre-Conceptual Design Phase Man-hour cost is as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Pre-Conceptual Design Phase.

The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be reestimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

Description of work	Hours	\$ Labor Cost	\$ Material	\$ Equip.	\$ SubCon	ODCs	Cont Lvl.
Description of work	Hours					1	
Conceptual Design Requirements							
Principal Engineer	40	\$5,600					3
Senior Engineer	80	\$11,200					3
Engineer	400	\$56,000					3
Designer				_			
Project Manager							
Quality Assurance							
Administrative Professionals	80	\$11,200					3
Project Controls							
Records/Document Management						Ī	
ES&H	80	\$11,200					3
Procurement							
Travel						\$4,250	3
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Confidence Level							
low good is the basis of estimate	low 1	2	3	4	5 high con	fidence	

1. PROJECT TITLE/	PARTICIPANT		2. Date of Preparation
NGNP CTF / MHI			2/12/2009
3. WBS Number	4. WBS Element Title		
1.2.1.2	Conceptual Design - 30MWt CTF Primary	/Secondary/Tertiary Test Loops	
5. Index Line No.	6. Revision No.		7. Revision Date
	Rev. 0		

#### 8. Work Statement

Work to be done: Perform 30 MWt CTF Conceptual Design for the Primary/Secondary/Tertiary Test Loops by using the design developed during the Pre-Conceptual Design phase to further develop the design requirements and detail. The design information will include updated system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g., flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. The equipment and component handling and installation requirements will be further developed. Major equipment includes: Primary/Secondary/Tertiary Test Loops, First/Second Stage Electric Heaters; High/Low Pressure Heat Exchangers, Hot Gas Mixing Tank, Primary/Secondary Hot Gas Ducts; Water Coolers; and primary/secondary Circulators.

Key Assumptions: Test Loop Design Duration is 15 Months

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Pre-Conceptual Design Phase. Man-hour cost is as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Pre-Conceptual Design Phase.

The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

io. Estimate Detail		\$	\$	\$	5	5	Conf.
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi.
Task #1		•					
Conceptual Design							
Principal Engineer (1)	960	\$134,400					4
Senior Engineer (3)	2880	\$403,200					4
Engineer (30)	28800	\$4,032,000					4
Designer (9)	8720	\$1,220,800					4
Project Manager							
Quality Assurance							
Administrative Professionals	960	\$134,400					4
Project Controls							
Records/Document Management	960	\$134,400					4
ES&H							
Procurement							
Travel						\$270,500	4
							_
Confidence Level						1	
low good is the basis of estimate	low 1	2	3	4	5 high con	fidence	

## WORK BREAKDOWN STRUCTURE DICTIONARY WBS ELEMENT DEFINITION 1. PROJECT TITLE/PARTICIPANT NGNP CTF / MHI 3. WBS Number 1.2.1.3 Conceptual Design - 30MWt CTF Instrument & Process Control 5. Index Line No. Rev. 0 Conceptual Design - 30MWt CTF Instrument & Process Control Rev. 0 7. Revision Date

#### 8. Work Statement

Work to be done: Perform 30 MWt CTF Instrument & Process Control Conceptual Design by using the design developed during the Pre-Conceptual Design phase to further develop the design requirements and detail. The design information will include updated system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. The equipment and component handling and installation requirements, instrumentation and control systems, and process and data acquisition software requirements will be further developed. Major equipment includes: I&C and Data Acquisition systems.

Key Assumptions: Instrument & Process Control Design Duration is 15 Months.

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Pre-Conceptual Design Phase. Man-hour cost is as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Pre-Conceptual Design Phase.

The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

). Estimate Detail		\$	\$	\$			Con
Description of work	Hours	Labor Cost	Material	Equip.	\$ SubCon	\$ ODCs	Lvi
Task #1							
Conceptual Design							
Principal Engineer	T		_		<u> </u>		
Senior Engineer (2)	1920	\$268,800					4
Engineer (4)	3846	\$538,440					4
Designer (2)	1920	\$268,800					4
Project Manager							
Quality Assurance					1		·
Administrative Professionals	470	\$65,800			<u> </u>	<u> </u>	4
Project Controls					L		
Records/Document Management	500	\$70,000			<u> </u>	<u> </u>	4
ES&H							
Procurement							<u> </u>
							<u> </u>
Travel						\$54,100	4
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1. PROJECT TITLE/	2. Date of Preparation		
NGNP CTF / MHI			2/12/2009
3. WBS Number	4. WBS Element Title		
1.2.2	Preliminary Design - 30MWt CTF		
5. Index Line No.	6. Revision No.		7. Revision Date
	Rev. 0		

#### 8. Work Statement

Work to be done: Perform 30 MWt CTF Preliminary Design by using the design developed during the Conceptual Design phase to further develop the design requirements and detail. The design information will include component level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the equipment specifications updated. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. The equipment and component handling and installation requirements, and instrumentation and control systems, and process and data acquisition software requirements will be refined. Major equipment includes: Primary/Secondary/Tertiary Test Loops, First/Second Stage Electric Heaters, IHX Heat Exchanger, Steam Generator, High/Low Pressure Heat Exchangers, Circulators, Control, Isolation, Check and Relief Valves; Purified Water System, Make Up Water System, Helium Sampling System, Pressurized Cooling Water System, Electrical Power System, Building and Building Services.

#### **Key Assumptions:**

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Conceptual Design Phase are filled into the table. Material price is as of December 2008 and any escalation is not taken into account. Man-hour cost is also as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Pre-Conceptual Design Phase. The basis of the cost estimation are as follows:

- (1) MHI input and experience
- (2) Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

#### 10. Estimate Detail

Description of work	Hours	\$ Labor Cost	► S Material	\$ Equip.	≱ SubCon	ODCs	Cor
	Hours	22201 0001	acoriai	-darb.	0100011		
Task #1							_
Preliminary Design							_
.2.2.1 30MWt CTF Design Requirements	500	\$70,000	0	\$0	\$0	\$0	_
1.2.2.2 Primary, Secondary and Tertiary Loops 30MW	65920	\$9,228,800	0	\$0	\$0	\$0	
.2.2.3 Instrument & Process Control 30MW	11984	\$1,677,760	0	\$0	\$0	\$0	
							-
Confidence Level							_

Confidence Level

How good is the basis of estimate low 1 2 3 4 5 high confidence

1. PROJECT TITLE/PARTICIPANT NGNP CTF / MHI		2. Date of Preparation 2/12/2009
3. WBS Number 1.2.2.1	4. WBS Element Title 30MWt CTF Design Requirements	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

#### 8. Work Statement

Work to be done: Further develop and update the 30 MWt CTF Preliminary Design requirements for the Primary/Secondary/Tertiary Test Loops and support systems that were developed during the Conceptual Design phase. Also as a part of this activity there is an interface with the TDRM validation to confirm the assumptions made for the testing to be performed at the CTF are still valid or to make adjustments in the CTF design.

Kev	Assı	ımn	tio	ns:

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Conceptual Design Phase Man-hour cost is as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Conceptual Design Phase.

The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be reestimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

10. Estimate Detail		\$	\$	2	2	\$	Conf
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	LvI.
Conceptual Design Requirements						<u> </u>	
Principal Engineer	40	\$5,600					3
Senior Engineer	40	\$5,600					3
Engineer	300	\$42,000					3
Designer							
Project Manager					<u></u>		_
Quality Assurance							
Administrative Professionals	40	\$5,600					3
Project Controls					1	}	
Records/Document Management							
ES&H	80	\$11,200					3
Procurement							
Travel						\$3,061	3
							Ī
Confidence Level							
low good is the basis of estimate	low 1	2	3	4	5 high con	fidence	

1. PROJECT TITLE/PARTICIPANT			2. Date of Preparation
NGNP CTF / MHI			2/12/2009
3. WBS Number	4. WBS Element Title		
1.2.2.2	Primary/Secondary/Tertiary Test Loops 3	OMWt	
5. Index Line No.	6. Revision No.		7. Revision Date
	Rev. 0		

#### 8. Work Statement

Work to be done: Perform 30 MWt CTF Preliminary Design for the Primary/Secondary/Tertiary Test Loops by using the design developed during the Conceptual Design phase to further develop the design requirements and detail. The design information will include updated system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. The equipment and component handling and installation requirements will be further developed. Major equipment includes: Primary/Secondary/Tertiary Test Loops, First/Second Stage Electric Heaters; High/Low Pressure Heat Exchangers, Hot Gas Mixing Tank, Primary/Secondary Hot Gas Ducts; Water Coolers; and primary/secondary Circulators.

Key Assumptions: Test Loop Design Duration is 17 Months

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Conceptual Design Phase. Man-hour cost is momentary value as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Conceptual Design Phase.

The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

. Colinate Detail		2	5	\$	\$		Cont
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi.
Task #1							
Principal Engineer	1462	\$204,705					3
Senior Engineer	4387	\$614,116					3
Engineer	43865	\$6,141,161					3
Designer	13281	\$1,859,407					3
Project Manager							
Quality Assurance							
Administrative Professionals	1462	\$204,705					4
Project Controls							
Records/Document Management	1462	\$204,705					4
ES&H							
Procurement							
Travel						\$403,525	
· ·							
						-	-
							_
						-	-
							_
							_
onfidence Level							
ow good is the basis of estimate	low 1	2	3	4	5 high con	fidence	

1. PROJECT TITLE	PARTICIPANT	2. Date of Preparation
NGNP CTF / MHI		2/12/2009
3. WBS Number	4. WBS Element Title	
1.2.2.3	Instrument & Process Control 30MWt	
5. Index Line No.	6. Revision No.	7. Revision Date
1	Rev. 0	

#### 8. Work Statement

Work to be done: Perform 30 MWt CTF Instrument & Process Control Preliminary Design by using the design developed during the Conceptual Design phase to further develop the design requirements and detail. The design information will include updated system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. The equipment and component handling and installation requirements, instrumentation and control systems, and process and data acquisition software requirements will be further developed. Major equipment includes: I&C and Data Acquisition systems.

Key Assumptions: Instrument & Process Control Design Duration is 15 Month.

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Conceptual Design Phase. Man-hour cost is as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Conceptual Design Phase.

The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

#### 10. Estimate Detail **Labor Cost** Material \$ SubCon \$ ODCs Lvl. Equip. Description of work Hours Task #1 Conceptual Design Principal Engineer Senior Engineer 2658 \$372,146 3 3 5325 \$745,456 Engineer 2658 \$372,146 3 Designer Project Manager Quality Assurance Administrative Professionals 651 \$91,098 4 Project Controls Records/Document Management 692 \$96,913 4 ES&H Procurement \$80,705 3 Travel Confidence Level How good is the basis of estimate low 1 5 high confidence

1. PROJECT TITLE/PARTICIPANT		2. Date of Preparation
NGNP CTF / MHI		2/12/2009
3. WBS Number	4. WBS Element Title	
1.2.3	Final Design - 30MWt CTF	
5. Index Line No.	6. Revision No.	7. Revision Date
3.0	Rev. 0	

#### 8. Work Statement

Work to be done: Perform 30 MWt CTF Final Design by using the design developed during the Preliminary Design phase to finalize the design requirements and documents. The design information will include component level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be finalized. The equipment/component specifications will be finalized to establish the procurement requirements. Building, equipment, and component handling and installation requirements, and instrumentation and control systems, and process and data acquisition software requirements will be finalized and approved. Major equipment includes: Primary/Secondary/Tertiary Test Loops, First/Second Stage Electric Heaters, IHX Heat Exchanger, Steam Generator, High/Low Pressure Heat Exchangers, Circulators, Control, Isolation, Check and Relief Valves; Purified Water System, Make Up Water System, Helium Sampling System, Pressurized Cooling Water System, Electrical Power System, and Building Services.

#### Key Assumptions:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Preliminary Design Phase are filled into the table, Material price is as of December 2008 and any escalation is not taken into account. Man-hour cost is also as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Pre-Conceptual Design Phase. The basis of the cost estimation are as follows:

- (1) MHI input and experience
- (2) Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

#### 10. Estimate Detail

TO. Estimate Detail	1	\$	\$	\$	\$	\$	Cont
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi.
Task #1							
Final Design							
1.2,3.1 30MWt CTF Design Requirements	500	\$70,000	\$0	\$0	\$0	\$0	
1.2.3.2 Primary, Secondary and Tertiary Loops 30MW	93200	\$13,048,000	\$0	\$0	\$0	\$582,500	
1.2.3.2 Primary, Secondary and Tertiary Loops 30MW 1.2.3.3 Instrument & Process Control 30MW	18640	\$2,609,600	\$0	\$0	\$0	\$116,500	
		,.					

Confidence Level

How good is the basis of estimate low 1 2 3 4 5 high confidence

1. PROJECT TITI	E/PARTICIPANT	2. Date of Preparation
NGNP CTF / MHI		2/12/2009
3. WBS Number	4. WBS Element Title	
1.2.3.1	Conceptual Design - 30MWt CTF Design Requirements	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

#### 8. Work Statement

Work to be done: Further develop and update the 30 MWt CTF Design requirements for the Primary/Secondary/Tertiary Test Loops and support systems that were developed during the Pre-Conceptual Design phase. Also as a part of this activity there is an interface with the TDRM validation to confirm the assumptions made for the testing to be performed at the CTF are still valid or to make adjustments in the CTF design.

**Key Assumptions:** 

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Pre-Conceptual Design Phase Man-hour cost is as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Pre-Conceptual Design Phase.

The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be reestimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

0. Estimate Detail		\$	\$	\$	\$	\$	Cont
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvì.
Conceptual Design Requirements						<u> </u>	
Principal Engineer	40	\$5,600					3
Senior Engineer	40	\$5,600					3
Engineer	300	\$42,000					3
Designer							
Project Manager							
Quality Assurance							
Administrative Professionals	40	\$5,600					4
Project Controls							
Records/Document Management							L.
ES&H	80	\$11,200					4
Procurement							
Travel						\$3,125	3
							L
						ļ	L
							<u> </u>
							ļ
					<u> </u>	<u> </u>	
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					<u> </u>		<u> </u>
onfidence Level		_	_				
ow good is the basis of estimate	low 1	2	3	4	5 high con	fidence	

1. PROJECT TITLE/F	PARTICIPANT		2. Date of Preparation
NGNP CTF / MHI			2/12/2009
3. WBS Number	4. WBS Element Title		
1.2.3.2	Primary/Secondary/Tertiary Test Loops 36	OMVVt	
5. Index Line No.	6. Revision No.		7. Revision Date
	Rev. 0		

#### 8. Work Statement

Work to be done: Perform 30 MWt CTF Final Design for the Primary/Secondary/Tertiary Test Loops by using the design developed during the Preliminary Design phase to further develop the design requirements and detail. The design information will include updated system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. The equipment and component handling and installation requirements will be further developed. Major equipment includes: Primary/Secondary/Tertiary Test Loops, First/Second Stage Electric Heaters; High/Low Pressure Heat Exchangers, Hot Gas Mixing Tank, Primary/Secondary Hot Gas Ducts; Water Coolers; and primary/secondary Circulators.

Key Assumptions: Test Loop Design Duration is 9 Months.

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Preliminary Design Phase. Man-hour cost is as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Preliminary Design Phase.

The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

Description of work	Hours	Labor Cost	\$ Material	\$ Equip.	\$ SubCon	ODCs	Conf Lvl.
		*					
Principal Engineer	2067	\$289,420					3
Senior Engineer	6202	\$868,259					3
Engineer Engineer	62018	\$8,682,588					3
Designer	18778	\$2,628,895					3
Project Manager							
Quality Assurance							
Administrative Professionals	2067	\$289,420					4
Project Controls							
Records/Document Management	2067	\$289,420					4
ES&H							
Procurement							
Travel						\$645,000	3
nfidence Level			2.			-	
v good is the basis of estimate	low 1	2	3	4	5 high con	fidence	

# WORK BREAKDOWN STRUCTURE DICTIONARY WBS ELEMENT DEFINITION 1. PROJECT TITLE/PARTICIPANT NGNP CTF / MHI 3. WBS Number 1.2.3.3 | Instrument & Process Control 30MWt 5. Index Line No. | 6. Revision No. | 7. Revision Date

#### 8. Work Statement

Work to be done: Perform 30 MWt CTF Instrument & Process Control Final Design by using the design developed during the Preliminary Design phase to further develop the design requirements and detail. The design information will include updated system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. The equipment and component handling and installation requirements, instrumentation and control systems, and process and data acquisition software requirements will be further developed. Major equipment includes: I&C and Data Acquisition systems.

Key Assumptions: Instrument & Process Control Design Duration is 5 Month.

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Preliminary Design Phase. Man-hour cost is as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Preliminary Design Phase.

The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

#### 10. Estimate Detail Cont. \$ SubCon \$ ODCs **Labor Cost** Material Equip. **Description of work** Hours Lvl. Principal Engineer 4135 \$578,839 3 Senior Engineer \$1,159,487 Engineer 8282 3 \$578,839 4135 3 Designer Project Manager Quality Assurance 1012 \$141,695 Administrative Professionals 4 **Project Controls** Records/Document Management 1077 \$150,739 4 ES&H Procurement \$116,500 3 Travel Confidence Level How good is the basis of estimate 3 5 high confidence low 1

1. PROJECT TITLE/F	PARTICIPANT		2. Date of Preparation
NGNP CTF / AREVA			2/12/2009
3. WBS Number	4. WBS Element Title		
1.2.4	Long Lead Procurement - 30MWt	CTF	
5. Index Line No.	6. Revision No.		7. Revision Date
	Rev. 0		

#### 8. Work Statement

Work to be done: In order to meet the CTF schedule, equipment with long lead times for delivery must be identified and procured during the 30MWt Conceptual Design Phase. This activity will include the development of the procurement specifications and procurement packages, evaluation and approval of suppliers, obtaining BEA and DOE approval, and award of the contracts. The items that have been identified as long lead items for the 30MWt CTF include the circulators, hot gas piping, steam generator, IHX heat exchanger, and electrical transformers 1 MVA or higher. (additional cost details for the 30MWt CTF Heaters are provided on the following supplemental WBS Sheet, 1.2.4(S).)

Key Assumptions: Funding for Long Lead Procurement will be made available during the Preliminary Design Phase.

Risk Elements: Material cost escalation, unavailability of funds, unavailability of workshop.

#### 9. Basis of Estimate

Methodology: A rough estimation value based on the result of the design developed during the Initial Conceptual Design Phase are filled into the table. Material price is as of December 2008 and any escalation is not taken into account. Man-hour cost is also as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Initial Conceptual Design Phase. Material cost is included in the SubCon column because final shaped material or rough machined material will be delivered to MHI and MHI will perform final machining and assembling. The bases of the cost estimation are as follows:

- (1) Price of material : Current Price as of December, 2008
- (2) Exchange rate : ¥100/US\$
- (3) Delivery conditions: FOB Japan (does not include cost of overseas transportation, construction, licensing/ permitting, start up and testing)
- (4) Design code of Pressure Vessel: ASME Sec. VIII Div. 1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

#### 10. Estimate Detail

Description of work	Hours	\$ Labor Cost	\$ Material	M\$ Final Machining & Assembling	\$ SubCon	\$ ODCs	Conf.
	400	050 000					2
Principal Engineer	400	\$56,000					3
Senior Engineer	800	\$112,000		_			3
Engineer	1200	\$168,000					3
Designer							
Project Manager							
Quality Assurance							
Administrative Professionals							
Project Controls							_
Records/Document Management	200	\$28,000					3
ES&H	300	\$42,000					3
Procurement	1000	\$140,000					3
Components:							
Electric Heater (EH1)				\$2,900,000	\$29,500,000		3
Electric Heater (EH2)				\$2,800,000	\$36,400,000		3
Water Cooler (WC1)				\$1,600,000	\$3,100,000		3
Water Cooler (WC2)				\$1,700,000	\$3,600,000		3
Primary Helium Circulator (PHC)				\$1,700,000	\$4,500,000		3
Secondary Helium Circulator (SHC)				\$1,500,000	\$4,200,000		3
Primary Hot Gas Ducts				\$6,000,000	\$13,600,000		3
Secondary Hot Gas Ducts				\$1,600,000	\$3,600,000		3
Hot Gas Mixing Tank				\$1,200,000	\$2,800,000		3
Common Cost				\$1,800,000	\$500,000		3
International Transportation						\$5,467,600	3
Electrical Transformers 1MVA or higher					\$3,105,000		3

low 1

5 high confidence

<b>WORK BREAKDOWN</b>	STRUCTURE	DICTIONARY
WBS ELEMI	ENT DEFINITI	ON

1. PROJECT TITLE/	WBS Number 4. WBS Element Title 4. Supplemental Long Lead Procurement - 30MWt CTF Heater Cost Details		2. Date of Preparation		
NGNP CTF / AREVA	NP CTF / AREVA 2/12/2009  WBS Number 4 Supplemental Long Lead Procurement - 30MWt CTF Heater Cost Details		1/16/2009		
	1 · · · · · · · · · · · · · · · · · · ·				
1.2.4 Supplemental	Long Lead Procurement - 30MWt CTF Heater Cost Details				
5. Index Line No.	6. Revision No.		7. Revision Date		
	Rev. 0	•			

Work to be done: This sheet provides additional cost detail for the 30MWt CTF Heaters included in previous WBS sheet 1.2.4.

**Key Assumptions:** 

Risk Elements:

#### 9. Basis of Estimate

Methodology: A rough estimation value based on the result of the design developed during the Initial Conceptual Design Phase are filled into the table. Material price is as of December 2008 and any escalation is not taken into account. Man-hour cost is also as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Initial Conceptual Design Phase. Material cost is included in the SubCon column because final shaped material or rough machined material will be delivered to MHI and MHI will perform final machining and assembling.

The basis of the cost estimation are as follows:

- (1) Price of material : Current Price as of December, 2008
- (2) Exchange rate : ¥100/US\$
- (3) Delivery conditions: FOB Japan (does not include cost of overseas transportation, construction, licensing/ permitting, start up and testing)
- (4) Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

Description of work	\$ Insulation	\$ Heater Element	\$ Graphite	M\$ Final Machining & Assembling	\$ Control Board	Control High Frequency Filter	\$ SubCon	\$ Total	Con Lvi
Components:									ļ
Electric Heater (EH1)	2300000	\$5,800,000	<del> </del>	\$2,900,000	\$7,300,000	\$6,500,000	\$7,600,000	\$32,400,000	3
Electric Heater (EH2)	2900000	\$5,900,000	\$6,000,000	\$2,800,000	\$7,300,000	\$6,500,000	\$7,800,000	\$39,200,000	3
									-
									-
									E
	<u></u>		l						<u> </u>

1.2.5 Construction - 30MWt Test Loop  5. Index Line No. 6. Revision No. Rev. 0	Date of Preparation 2/12/2009      Revision Date
1.2.5 Construction - 30MWt Test Loop 5. Index Line No. 6. Revision No.	7. Revision Date
Rev. 0	7. Revision Date
** - 0 0	
Nork to be done: 2222222	
Key Assumptions: Funding for procurement and installation will be available during the construction phase. Prograin NGNP TDRMs and test plans do not have a significant impact on the CTF System Requirements or equipment speci	

#### 9. Basis of Estimate

Methodology: Estimate based on experience from previous projects

Description of work	Hours	Labor Cost	5 Material	\$ Equip.	SubCon	ODCs	Lvi
1,2,5,1 30MWt Test Loop Installation	1736	\$243,040	\$0	\$2,992,000	\$66,346,000	\$0	
1 2 5 2 Instrument & Process Control 30MW	0	\$0	\$785,955	\$0	\$0	\$0	
							ť
							_
good is the basis of estimate	low 1	2	3	4	5 high conf	idence	

## WORK BREAKDOWN STRUCTURE DICTIONARY WBS ELEMENT DEFINITION 1. PROJECT TITLE/PARTICIPANT NGNP CTF / AREVA 3. WBS Number 1.2.5.1 4. WBS Element Title 30MWt Test Loop Installation 5. Index Line No. Rev. 0 7. Revision Date

#### 8. Work Statement

Work to be done: Procure and install the equipment, piping, and electrical power for the 30 MWt Primary and Secondary Test Loops.

Activities: procure Primary Loop process equipment and piping; procure Secondary Loop process equipment and piping; procure Test Section process equipment and piping; procure Tertiary Loop process equipment and piping; procure Primary Loop electrical power mat'l; procure Secondary Loop electrical power mat'l; procure Test Section electrical power mat'l.

Activities install Primary Loop process equipment and piping; install Secondary Loop process equipment and piping; install Test Section process equipment and piping; install electrical power for Primary Loop; install electrical power for Secondary Loop; install electrical power for Test Section; install electrical power for Tertiary Loop.

Key Assumptions: Funding for procurement and installation will be available during the construction phase. Programmatic changes and revisions to the NGNP TDRMs and test plans do not have a significant impact on the CTF System Requirements or equipment specifications. Assumed 2 construction contractors ( Mechanical and Electrical) will be used. Major equipment will be provided to the constructors. The material (pipe, cable, steel, bolting, etc.), tools, equipment, and labor needed to install the components and construct the building are included in the constructor subcontract cost.

Risk Elements: NGNP mission, priorities, and funding are revised annually

9. Bas		

Methodology: Estimate based on experience from previous projects.

v. Estimate Detail		\$	\$	\$	2	\$	Cont
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi.
rocurement of 30 MWt Test Loop Constructors							
Principal Engineer	80	\$11,200					3
Senior Engineer	80	\$11,200					3
Engineer	688	\$96,320					3
Designer							
Project Manager							
Quality Assurance	40	\$5,600					3
Administrative Professionals							
Project Controls							
Records/Document Management	80	\$11,200					3
ES&H	80	\$11,200					3
Procurement	688	\$96,320					3
stallation of 30 MWt Test Loop Items							
Mechanical Constructor					\$42,773,500		3
Electrical Constructor					\$23,572,500		3
No. 1				#2 002 000			3
Non-long lead equipment cost				\$2,992,000			

I. PROJECT TITLE/PARTICIPANT		2. Date of Preparation
NGNP CTF / AREVA		2/12/2009
3. WBS Number	4. WBS Element Title	
1.2.5.2	Instrumentation and Process Control 30	MWt
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

#### 8. Work Statement

#### Work to be done:

Procure materials and contractor to install the computer and data collection and storage system, temperature, pressure and flow control and monitoring for the 1 and 30 MWt test loop and test sections. This will also include other loop parameters that will need control and monitoring.

- 1. Commercially available instruments can be used and no R&D is required.
- 2. Temperature, pressure and flow instruments on the test sections is not provided. They will be provided by the supplier of the test sections.
- 3. Major Equipment Provided by the Project.
- 4. Installation Costs for this element are included in 1.1.5.2.

#### Risk Elements:

We may not be able to find commercially available instruments for high temperature helium gas application.

Process temperature will need to be reduced to the levels acceptable by the instruments proposed.

#### 9. Basis of Estimate

Methodology: Estimates based on RS Means, experience from previous projects and preliminary cost information from potential suppliers.

10. Estimate Detail

		Labor Cook	\$	\$ 	Sb.C.=	5	Cor
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	LV
		•					
MATERIAL							
Temperature elements			\$161,375				3
Pressure transmitters			\$244,250				3
Flow elements			\$380,330			-	;
						-	
							-
						-	
						1	-

How good is the basis of estimate low 1 2 3 5 high confidence

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#### 8. Work Statement

Rev. 0

Work to be done: Perform Conceptual Design by using the design developed during the Pre-Conceptual Design phase to further develop the design requirements and detail. The design information will include updated system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. The equipment and component handling and installation requirements, instrumentation and control systems, and process and data acquisition software requirements will be further developed. Water Coolers; Circulators; Control, Isolation, Check and Relief Valves; Nitrogen Supply System, Purified Water System, Make Up Water System, Chemical Supply Systems, Helium Purification System, Helium Supply and Storage System, Cooling Water System, Compressed Air System, Electrical Power System, I&C and Data Acquisition, and Building and Building Services.

Key Assumptions:

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Pre-Conceptual Design Phase are filled into the table. Material price is as of December 2008 and any escalation is not taken into account. Man-hour cost is as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Pre-Conceptual Design Phase. The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

\$	\$	\$	\$	Cont
t Material	Equip.	SubCon	ODCs	Lvi.
0 \$0	\$0	\$0	\$0	
0 \$0	\$0	\$0	\$0	<u> </u>
				1
				1
			1	1
				1
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				1
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	3	3 4	3 4 5 high conf	3 4 5 high confidence

1. PROJECT TITLE	PARTICIPANT	2. Date of Preparation
NGNP CTF / AREVA	\	2/12/2009
3. WBS Number	4. WBS Element Title	
1.3.1.1	Building and Utilities CD	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

#### 8. Work Statement

Work to be done: Perform CTF Site, Building, and Building Services Conceptual Design by using the design developed during the Pre-Conceptual Design phase to further develop the design requirements and detail. The design information will include further developed system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Equipment and component handling and installation requirements, instrumentation and control systems, requirements will be further developed. Major equipment and support systems includes: Main Electrical Power System, HVAC, and Building and Building Services. Cooling Water Towers, Emergency Power System, Storm Water, Sanitary Water, Fresh Water, Fire Protection.

Key Assumptions: Conceptual Design - Site, Building, and Building Services Duration is 15 Months

Risk Elements:

#### 9. Basis of Estimate

Methodology: Use of RS Means and past project experience, A rough estimation value based on the result of the design developed during the Pre-Conceptual Design Phase are filled into the table. Man-hour cost is as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Pre-Conceptual Design Phase. The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be reestimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

#### 10. Estimate Detail Cont. **Labor Cost Material** Equip. SubCon **ODCs** LvI. Description of work Hours Task #1 \$76,800 Principal Engineer 640 \$288,000 3 2400 Senior Engineer Engineer 7040 \$844,800 3 3 3520 \$422,400 Designer Project Manager Quality Assurance 3 680 \$81,600 Administrative Professionals **Project Controls** 3 320 \$38,400 Records/Document Management ES&H Procurement \$77,130 3 Travel Confidence Level 5 high confidence How good is the basis of estimate low 1 2 3 4

1. PROJECT TITLE/	PARTICIPANT	2. Date of Preparation 2/12/2009
3. WBS Number 1.3.1.2	4. WBS Element Title Support Systems CD	
5. Index Line No.	6. Revision No. Rev. 0	7. Revision Date

#### 8. Work Statement

Work to be done: Perform CTF Support Systems Conceptual Design by using the design developed during the Pre-Conceptual Design phase to further develop the design requirements and detail. The design information will include updated system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. The equipment and component handling and installation requirements will be further developed. Major equipment includes: Purified Water System, Make Up Water System, Helium Sampling System, Pressurized Cooling Water System, He Purification System, He Storage and Supply System, Cooling Water System, Chemical Supply System, Waste Water Treatment, Heat Trace System, Compressed Air System, Nitrogen Gas System

Key Assumptions: Support System Design Duration is 15 Months.

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Pre-Conceptual Design Phase. Man-hour cost is as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Pre-Conceptual Design Phase.

The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

v. Csumate Detail		\$	\$		\$	7	Conf.
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	LvI.
Task #1		· · · · · · · · · · · · · · · · · · ·					
Conceptual Design							
Principal Engineer							
Senior Engineer (2)	1042	\$145,880					3
Engineer (12)	5040	\$705,600			1		3
Designer (4)	2572	\$360,080					3
Project Manager	1200	\$168,000		-			3
Quality Assurance					}	}	
Administrative Professionals	320	\$44,800					3
Project Controls	360	\$50,400					3
Records/Document Management	320	\$44,800				1	3
ES&H							
Procurement							
Travel						\$60,529	3
						<b> </b>	
<del></del>							
					<del>                                     </del>	<u> </u>	
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						1	<b>-</b>
Confidence Level					·	<u></u>	
low good is the basis of estimate	low 1	2	3	4	5 high conf	fidence	

1. PROJECT TITLE/I	PARTICIPANT		2. Date of Preparation
NGNP CTF / MHI			2/12/2009
3. WBS Number	4. WBS Element Title		
1.3.2	Preliminary Design - Building and BOP Sy	stems	
5. Index Line No.	6. Revision No.		7. Revision Date
	Rev. 0		

#### 8. Work Statement

Work to be done: Perform Preliminary Design by using the design developed during the Conceptual Design phase to further develop the design requirements and detail. The design information will include updated system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. The equipment and component handling and installation requirements, instrumentation and control systems, and process and data acquisition software requirements will be further developed. Water Coolers; Circulators; Control, Isolation, Check and Relief Valves; Nitrogen Supply System, Purified Water System, Make Up Water System, Chemical Supply Systems, Helium Purification System, Helium Supply and Storage System, Cooling Water System, Compressed Air System, Electrical Power System, I&C and Data Acquisition, and Building and Building Services.

Key Assumptions:

-

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Conceptual Design Phase are filled into the table. Material price is as of December 2008 and any escalation is not taken into account. Man-hour cost is as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Conceptual Design Phase. The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

Description of work	Hours	Labor Cost	5 Material	Ş Equip.	SubCon	ODCs	Lvi.
1.3.2.1 Building and Utilities PD	17700	\$2,124,000	\$0	\$0	\$0	\$0	
1.3.2.2 Support Systems PD	13350	\$1,869,000	0	\$0	\$0	\$0	
			_				
confidence Level low good is the basis of estimate	low 1	2	3	4	5 high confid	lence	

WORK BREAKDOWN STRUCTURE DICTIONARY	′
WRS ELEMENT DEFINITION	

1. PROJECT TITLE	PARTICIPANT	2. Date of Preparation
NGNP CTF / AREVA		2/12/2009
3. WBS Number	4. WBS Element Title	
1.3.2.1	Building and Utilities PD	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

#### Work to be done:

Perform CTF Site, Building, and Building Services Preliminary Design by using the design developed during the Conceptual Design phase to further develop the design requirements and detail. Includes Final design for underground utilities and building foundations in support of CD-2/3A submittal. The design information will include further developed system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Equipment and component handling and installation requirements, instrumentation and control systems, requirements will be further developed. Major equipment and support systems includes: Main Electrical Power System, HVAC, and Building and Building Services, Cooling Water Towers, Emergency Power System, Storm Water, Sanitary Water, Fresh Water, and Fire Protection.

#### **Key Assumptions:**

Preliminary Design - Site, Building, and Building Services Duration is 15 Months.

#### Risk Elements:

#### 9. Basis of Estimate

How good is the basis of estimate

Methodology: Use of RS Means and past project experience.

10. Estimate Detail		\$	\$	2	\$	2	Con
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi.
ask		•					
Principal Engineer							3
Senior Engineer	1041	\$124,941					3
Engineer	11106	\$1,332,706				<del> </del>	3
Designer	5553	\$666,353				· · · · · · · · · · · · · · · · · · ·	۱ŭ
Project Manager	- 1 3333	Ψ000,550				-	
Quality Assurance							
Administrative Professionals						+	-
Project Controls							
Records/Document Management						+	
ES&H							
Procurement							
Travel						\$77,130	3
I lave					<b></b>	Ψ//,130	۳
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Confidence Level			l				<u> </u>

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3

5 high confidence

2

WORK BREAKDOWN S	TRUCTURE DICTIONARY
WBS ELEME	NT DEFINITION

1. PROJECT TITLE/	PARTICIPANT	2. Date of Preparation
NGNP CTF / AREVA	\	2/12/2009
3. WBS Number	4. WBS Element Title	
1.3.2.2	Support Systems PD	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

#### Work to be done:

Perform CTF Support Systems Conceptual Design by using the design developed during the Pre-Conceptual Design phase to further develop the design requirements and detail. The design information will include updated system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. The equipment and component handling and installation requirements will be further developed. Major equipment includes: Purified Water System, Make Up Water System, Helium Sampling System, Pressurized Cooling Water System, He Purification System, He Storage and Supply System, Cooling Water System, Chemical Supply System, Waste Water Treatment, Heat Trace System, Compressed Air System, Nitrogen Gas System

Key Assumptions: Duration is 15 Months.

Risk Elements:

#### 9. Basis of Estimate

Methodology: Use customary and standard engineering practices.

#### 10. Estimate Detail

		\$	\$	_ \$	\$	\$	Con
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi
Principal Engineer	1230	\$172,246					3
Senior Engineer	3673	\$514,168					3
Engineer	3673	\$514,168					3
Designer	3673	\$514,168					3
Administrative Professionals	1102	\$154,250					3
Travel						\$60,529	3

Confidence Level

How good is the basis of estimate low 1 2 3 4 5 high confidence

1. PROJECT TITLE	E/PARTICIPANT	2. Date of Preparation
NGNP CTF / MHI		2/12/2009
3. WBS Number	4. WBS Element Title	
1.3.3	Final Design - Buildings and Support Systems	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev 0	

#### 8. Work Statement

Work to be done: Perform Final Design by using the design developed during the Preliminary Design phase to further develop the design requirements and detail. The design information will include updated system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. The equipment and component handling and installation requirements, instrumentation and control systems, and process and data acaquisition software requirements will be further developed. Water Coolers; Circulators; Control, Isolation, Check and Relief Valves; Nitrogen Supply System, Purified Water System, Make Up Water System, Chemical Supply Systems, Helium Purification System, Helium Supply and Storage System, Cooling Water System, Compressed Air System, Electrical Power System, I&C and Data Acquisition, and Building and Building Services.

Key Assumptions:

Risk Elements:

#### 9. Basis of Estimate

**Methodology**: A rough estimation value based on the result of the design developed during the Preliminary Design Phase are filled into the table. Material price is as of December 2008 and any escalation is not taken into account. Man-hour cost is as of December 2008 and estimated based on the work volume assumed in accordance with the result of the design developed during the Preliminary Design Phase. The basis of the cost estimation are as follows:

MHI input and experience

Design code of Pressure Vessel: ASME Sec. VIII Div.1, U-stamp

Note: This cost estimation is on a non-binding basis and submitted only for the purpose of the technical evaluation. Quotation is to be re-estimated at the bidding stage in accordance with material market, final design, and general terms and conditions.

Description of work	Hours	\$ Labor Cost	\$ Material	\$ Equip.	\$ SubCon	\$ ODCs	Conf.
Description of work	Hours		material				
1.3.3.1 Building and Utilities FD 1.3.3.2 Support Systems FD	26100	\$3,132,000	\$0	\$0	\$0	\$0	
1.3.3.2 Support Systems FD	18342	\$2,567,880	\$0	\$0	\$0	\$0	
				<del>-</del>			
							-
							<b></b>
					1		
Confidence Level	la 4	2	2	4	S binb no S		
How good is the basis of estimate	low 1	2	3	4	5 high confid	ence	

WORK BREAKDOWN STRUCTURE DICTIONA	RY
WBS FLEMENT DEFINITION	

1. PROJECT TITLE/	PARTICIPANT	2. Date of Preparation
NGNP CTF / AREVA		2/12/2009
3. WBS Number	4. WBS Element Title	· · · · · · · · · · · · · · · · · · ·
1.3.3.1	Building and Utilities FD	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

#### Work to be done:

Perform CTF Site, Building, and Building Services Final Design by using the design developed during the Preliminary Design phase to further develop the design requirements and detail. The design information will include further developed system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Equipment and component handling and installation requirements, instrumentation and control systems, requirements will be further developed. Major equipment and support systems includes: Main Electrical Power System, HVAC, and Building and Building Services, Cooling Water Towers, Emergency Power System, Storm Water, Sanitary Water, Fresh Water, and Fire Protection.

#### Key Assumptions:

Final Design - Site, Building, and Building Services Duration is 8 Months.

Risk Elements:

Q	Raci	ie of	Fet	imate

Confidence Level

How good is the basis of estimate

Methodology: Use of RS Means and past project experience.

10. Estimate Detail		5	5	\$	5	5	Cont.
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi.
Task		3.					
Principal Engineer							
Senior Engineer	3930	\$471,642					3
Engineer	15721	\$1,886,569					3
Designer	5896	\$707,464					3
Project Manager							
Quality Assurance							
Administrative Professionals	553	\$66,325					3
Project Controls							
Records/Document Management							
ES&H							
Procurement							
Travel						\$110,000	3
						-	
						1	
						1	

42 of 60

low 1

2

3

4

5 high confidence

	WORK BREAKDOWN STRUCTURE DICTIONARY WBS ELEMENT DEFINITION				
1. PROJECT TITLI		2. Date of Preparation 2/12/2009			
3. WBS Number 1.3.3.2	4. WBS Element Title Support Systems FD				
5. Index Line No.	6. Revision No. Rev. 0	7. Revision Date			

#### Work to be done:

Perform CTF Support Systems Final Design by using the design developed during the Preliminary Design phase to further develop the design requirements and detail. The design information will include updated system level equipment lists, design specifications, PFDs and P&IDs, schematics and layouts, and appropriate details of major systems. The technical and functional requirements for performance test (e.g. flow induced vibration, materials performance, and seals leak rates) instrumentation will be updated and the initial equipment specifications developed. Included in the conceptual test loop design will be the identification of any R&D needed for the test loop components. The equipment and component handling and installation requirements will be further developed. Major equipment includes: Purified Water System, Make Up Water System, Helium Sampling System, Pressurized Cooling Water System, He Purification System, He Storage and Supply System, Cooling Water System, Chemical Supply System, Waste Water Treatment, Heat Trace System, Compressed Air System, Nitrogen Gas System.

Key Assumptions: Duration is 9 months.

Risk Elements:

#### 9. Basis of Estimate

Methodology: Use customary and standard engineering practices.

10. Estimate Detail

		\$	\$	<u> </u>	\$	•	Con
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi
	1690	\$226 655					3
Principal Engineer		\$236,655				_	3
Senior Engineer	5046	\$706,432				<del> </del>	
Engineer	5046	\$706,432					3
Designer	5046	\$706,432					] 3
Administrative Professionals	1514	\$211,930					3
Travel						\$87,375	3
							⊢
						<del>                                     </del>	<b> </b>

Confidence Level

How good is the basis of estimate low 1 2 3 4 5 high confidence

WORK	BREAKDOWN STRUCTURE DICTIONARY
	WRS ELEMENT DEFINITION

1. PROJECT TITLE/PARTICIPANT	2. Date of Preparation	
NGNP CTF / AREVA		2/12/2009
3. WBS Number	4. WBS Element Title	
1.3.4	Construction - Building and Support Systems	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

Work to be done: Develop the procurement packages, evaluate and approve the suppliers, obtain BEA and DOE approval, and award the contracts to procure the services of the constructor(s), and to procure the equipment, components, and materials to prepare the site, construct the building, install the utilities; fabricate and install the building services, and CTF support systems; and to complete the parking and grounds.

Prepare the site, construct the building, install the utilities; fabricate and install the building services, CTF support systems; and to complete the parking and grounds.

Perform testing and turnover of the building, building services, utilities, CTF support systems to confirm the design and procurement requirements have been satisfied. During the construction phase there will be project oversight/support of the construction activities. These include engineering/design change control, Construction Management, ES&H, QA, Project Controls, Administrative Support, Procurement, Records/Document Management, and Information Technology.

Key Assumptions: 30MWt Construction phase overlaps 1MWt Construction Phase, 30MWt Construction Phase goes 17 Months after 1MWt Construction Phase ends

Risk Elements:

#### 9. Basis of Estimate

Methodology: 1. The project scope and methodologies for this estimate were prepared from pre-conceptual design documents and input from project team. 2. The NGNP Preliminary Design estimate is the basis for the CTF, 3. The CTF buildings are based on the NGNP Radwaste Building (concrete structure) and the NGNP Administration Building (metal sided structural steel).4. Quantities were scaled as necessary to suit the CTF design, 5. Material costs from the NGNP estimate were escalated to current day dollars. 6. Labor hours from the NGNP estimate were used as is. All were factored for productivity. Current labor rates were applied, 7. INL provided the craft wage rates in an April 18, 2007 e-mail, 8. Craft labor will work a 4-10's workweek. 9. Cost of overtime is not included. Central Facility Area (CFA) at no cost to the project will accept excavated spoil. Cost of defining, excavating and transporting contaminated soil is not included, 10. Fill material will be furnished to the project at no cost by CFA. 11. Unit pricing, as required, was obtained from RS Means cost data books, "Trade Services Pricing" book, vendor quotes, vendor price lists and historical data. 12. Local vendors were polled for preliminary quotes for supply of concrete, reinforcing steel and structural steel for NGNP.

10. Estimate Detail Cont. Labor Cost Material Equip. SubCon **ODCs** Lvl Description of work Hours Task #1 1.3.4.1 Building Construction 2380 \$333,200 \$0 \$0 \$67,325,806 \$0 1.3.4.2 Building Furnishings 440 \$61,600 \$20,000 \$508,358 \$14,000 \$0 \$2,654,100 1.3.4.3 Support Systems 308 \$43,120 \$3,780,000 \$0 Confidence Level 5 high confidence How good is the basis of estimate low 1 2 3 4

# WORK BREAKDOWN STRUCTURE DICTIONARY WBS ELEMENT DEFINITION

1. PROJECT TITLE/PARTICIPANT		2. Date of Preparation
NGNP CTF / AREVA		2/12/2009
3. WBS Number	4. WBS Element Title	
1.3.4.1	Building Construction	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

#### 8. Work Statement

#### Work to be done:

The scope consists of the construction of the Facility Foundation, Excavation & Backfill, C.I.P. Concrete, Metals, Architectural/Interior Finishes, Mechanical, Electrical and site Improvements.

Key Assumptions: 1. The proposed work scope will not exceed the activities and/or quantities as shown on the cost estimating detail sheets.

- 2. The technical and functional requirements (T&FR's) are included in this cost estimate for this work.
- 3. All costs are March 2008 dollars.
- 4. No allowance is included for any unknown existing underground utilities.
- 5. Landscaping is not included.
- 6. No allowances for complications due to extreme weather have been included in this estimate.
- 7. This estimate assumes that a general contractor will be the prime contractor on the project and will subcontract scope as needed.
- 8. A subsistence allowance is included based on approximately 60% of craft as "travelers".
- 9. Costs are not included for the removal, testing, boxing and transporting of contaminated soil to the CFA.
- 10. It has been assumed only one mobilization and demobilization will be needed with no interruption.
- 11. No monies are included for any governmental fees or permits.
- 12. Facility power will be taken from local sources.

Risk Elements: A. No detailed design exists for this project. B. Subsurface rock elevations have not been fully identified. Should rock be found in the areas where only soil is assumed to be, this will increase the construction and oversight costs and performance period. C. This project is heavily dependent on cement, steel, copper, and petroleum products.

#### 9. Basis of Estimate

Methodology: 1.The project scope and methodologies for this estimate were prepared from pre-conceptual design documents and input from project team. 2.The NGNP Preliminary Design estimate is the basis for the CTF. 3.The CTF buildings are based on the NGNP Radwaste Building (concrete structure) and the NGNP Administration Building (metal sided structural steel).4. Quantities were scaled as necessary to suit the CTF design. 5.Material costs from the NGNP estimate were escalated to current day dollars.
6.Labor hours from the NGNP estimate were used as is. All were factored for productivity. Current labor rates were applied. 7. INL provided the craft wage rates in an April 18, 200' e-mail. 8. Craft labor will work a 4-10's workweek. 9.Cost of overtime is not included. Central Facility Area (CFA) at no cost to the project will accept excavated spoil. Cost of defining, excavating and transporting contaminated soil is not included. 10. Fill material will be furnished to the project at no cost by CFA. 11. Unit pricing, as required, was obtained from RS Means cost data books, "Trade Services Pricing" book, vendor quotes, vendor price lists and historical data. 12. Local vendors were polled for preliminary quotes for supply of concrete, reinforcing steel and structural steel for NGNP.

10. Estimate Detail		\$	\$	\$			Cont
Description of work	Hours	Labor Cost	Material	Equip.	\$ SubCon	\$ ODCs	Lvi.
Procurement of Building Constructors							
Principal Engineer	80	\$11,200					3
Senior Engineer	80	\$11,200					3
Engineer	1000	\$140,000					3
Designer							
Project Manager							
Quality Assurance	40	\$5,600					3
Administrative Professionals							
Project Controls							
Records/Document Management	80	\$11,200					3
ES&H	100	\$14,000					3
Procurement	1000	\$140,000					3
Construction of Building & Building Services							
Foundation, Excavation & Backfill					\$620,364		3
C.I.P. Concrete					\$39,478,213		3
Metals					\$2,922,970		3
Architectural/Interior Finishes			<u></u> į.		\$2,235,439		3
Mechanical					\$6,062,629		3
Electrical					\$14,765,138		3
Site Improvements					\$1,028,531		3
					<u> </u>		
					<u> </u>		
							<u> </u>

Confidence Level	Confid	dence	Level
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WORK BREAKDOWN STRUCTURE DICTIONARY	,
WRS ELEMENT DEFINITION	

1. PROJECT TITLE/PAR	TICIPANT	2. Date of Preparation
NGNP CTF / AREVA		2/12/2009
3. WBS Number	4. WBS Element Title	
1.3.4.2	Building Furnishings	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

Work to be done: Procure and install facility furnishings in the CTF facility.

Key Assumptions: CTF staff consists of ~41 FTEs. One time cost for office furniture, small appliances, shelving, storage cabinets etc. Small tools and equipment are not included in this element.

Risk Elements:

## 9. Basis of Estimate

# Methodology:

RS Means source for office furnishings costs (desks, chairs, file cabinets, PCs etc.).

#### 10. Estimate Detail

		\$	\$	\$	\$	\$	Conf.
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvl.
rocurement of CTF Furnishings							
Principal Engineer							
Senior Engineer							
Engineer	40	\$5,600					3
Designer							
Project Manager							
Quality Assurance							
Administrative Professionals							
Project Controls							
Records/Document Management	80	\$11,200					3
ES&H							
Procurement	320	\$44,800					3
Procure Control Room Furnishings			\$10,000	\$5,000			2
Procure Office Furnishings & computers			\$2,000	\$132,858			2
Procure Shop Furnishings			\$6,000	\$360,000			2
Procure Equipment Room Furnishings			\$2,000	\$10,500			2
Install Control Room Furnishings					\$1,000		2
Install Office Furnishings					\$1,000		2
Install Shop Furnishings					\$2,000		2
Install Equipment Room Furnishings					\$10,000		2

# Confidence Level

WORK BREAKDOWN STRUCTURE DICTIONARY WBS ELEMENT DEFINITION					
1. PROJECT TITLE NGNP CTF / AREV		2. Date of Preparation 2/12/2009			
3. WBS Number 1.3.4.3	WBS Element Title     Support Systems				
5. Index Line No.	6. Revision No. Rev. 0	7. Revision Date			

Work to be done: Procure and install support systems consisting of He purification and storage, chemical supply, heat trace, compressed air, nitrogen gas, make-up water, pressurized cooling water, helium sampling, and purified water production, Primary Helium Purification System; Secondary Helium Purification System, Helium Storage and Supply, Cooling Water System, and Waste Water System. Procure and install electrical connection devices such as variable speed drives, motor starters and disconnects for pump motors, fan motors, compressor motors, and heat trace self regulating cable. Install and connect applicable fluid and gas piping. Provide design support to support both procurement and installation as well as producing design change paper for field modifications.

Key Assumptions: Some of the off-the-shelf equipment/systems may come with their own motor/pump/fan control panels making electrical connections straight forward. Support Systems Installation Duration is 15 Months. Major equipment provided by the project.

Risk Elements: Material cost escalation, unavailability of funds, time to deliver greater than 6 months.

#### 9. Basis of Estimate

Methodology: Estimate based on experience from previous projects.

10. Estimate Detail

		\$	\$	\$	\$	\$	Conf.
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvl.
Principal Engineer	20	\$2,800					3
Senior Engineer	40	\$5,600					3
Engineer	100	\$14,000					3
Designer							
Project Manager							
Quality Assurance	16	\$2,240					3
Administrative Professionals							
Project Controls							
Records/Document Management	16	\$2,240					3
ES&H	16	\$2,240					3
Procurement	100	\$14,000			- 1		3
Mechanical Equipment				\$3,780,000			2
Mechanical Support Systems Installer					\$1,727,665		2
Electrical Support Systems Installer					\$926,435		2
							<u> </u>
						L	<b> </b>
		I	l				L

Confidence Level

How good is the basis of estimate

low 1

2

3

<b>WORK BREAKDOWN STRUCTURE DICTIONARY</b>	,
WBS ELEMENT DEFINITION	

1. PROJECT TITLE/F	I. PROJECT TITLE/PARTICIPANT		
NGNP CTF / AREVA			2/12/2009
3. WBS Number	4. WBS Element Title		
1.4.1	CTF - Facility Turnover and Testin	g	
5. Index Line No.	6. Revision No.		7. Revision Date
	Rev. 0		

Work to be done: Perform CTF turnover and testing activities of the 1MWt and 30MWt Test Loops

Key Assumptions: Programmatic changes and revisions to the NGNP TDRMs and test plans do not have a significant impact on the CTF Mission Requirements, Turnover and testing duration is 3 Months.

Risk Elements: NGNP mission needs, priorities, and funding are revised annually, Late changes to CTF mission needs or design requirements will impact pre-operational testing.

## 9. Basis of Estimate

Methodology: Experience with similar projects.

## 10. Estimate Detail

TV. Estimate Detail		\$	\$	\$	\$	1 \$	Conf
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	LvI.
Facility Turnover and Testing of the 1 MWt and 30 MWt Test							
Principal Engineer	80	\$11,200					3
Senior Engineer	240	\$33,600					3
Engineer (4)	1920	\$268,800					3
Tech Specialist (4)	1920	\$268,800					3
Mechanics	960	\$134,400					3
Electricians	960	\$134,400					3
Electrical Foreman	480	\$67,200					3
Mechanical foreman	480	\$67,200					3
I&C technicians	960	\$134,400					3
Materials			\$40,000				2
Ti.							

Confidence Level

How good is the basis of estimate

low 1

2

3

WORK BREAKDOWN STRUCTURE DICTIONARY WBS ELEMENT DEFINITION						
1. PROJECT TITLE/ NGNP CTF / AREVA		2. Date of Preparation 2/12/2009				
3. WBS Number 1.4.2	4. WBS Element Title CTF Programs and Procedures					
5. Index Line No.	6. Revision No. Rev. 0	7. Revision Date				

Work to be done: Perform CTF Programs and Procedures activities including development of ES&H and Waste programs and procedure development for operations.

Key Assumptions: Programmatic changes and revisions to the NGNP TDRMs and test plans do not have a significant impact on the CTF Mission Requirements.

Risk Elements: NGNP mission needs, priorities, and funding are revised annually. Late changes to CTF mission needs or design requirements will impact the number and scope of procedure development.

# 9. Basis of Estimate

How good is the basis of estimate

Methodology: Experience with similar projects.

		\$	\$	\$	\$	2	Cor
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lv
Pevelop ES&H and Waste Programs							
Principal Engineer	80	\$11,200					3
Senior Engineer	160	\$22,400					3
Engineer							
Administrative Professionals	80	\$11,200					3
ES&H	320	\$44,800					3
Develop Procedures for Operations & Maintenance							
Principal Engineer	80	\$11,200					3
Senior Test Engineer	320	\$44,800					3
Test Engineer	320	\$44,800					3
Administrative Professionals	320	\$44,800					3
Plant Engineer	640	\$89,600					3
IT	320	\$44,800		·			3
QA	320	\$44,800					3
Senior Operator	640	\$89,600					3
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						1	
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49of60

2

3

4

5 high confidence

low 1

# WORK BREAKDOWN STRUCTURE DICTIONARY WBS ELEMENT DEFINITION

1. PROJECT TITLE	PARTICIPANT	2. Date	e of Preparation
NGNP CTF / AREVA	<b>\</b>		2/12/2009
3. WBS Number	4. WBS Element Title		
1.4.3	CTF Training		
5. Index Line No.	6. Revision No.	7. R	Revision Date
	Rev. 0		

## 8. Work Statement

Work to be done: Perform CTF Training activities including development of training for test loop operations and training of test loop operators.

Key Assumptions: Programmatic changes and revisions to the NGNP TDRMs and test plans do not have a significant impact on the CTF Mission or the number and types of tests planned for the facility.

Risk Elements: NGNP mission needs, priorities, and funding are revised annually. Late changes to CTF mission needs, design or test requirements may impact the training requirements.

# 9. Basis of Estimate

Methodology: Experience with similar projects,

## 10. Estimate Detail

		5	\$	\$	5	3	Con
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi.
Training development for operations							
Principal Engineer	160	\$22,400		-			3
Senior Engineer	640	\$89,600					3
Engineer							
Administrative Professionals	160	\$22,400					3
Training of CTF operators							
Facility Manager	80	\$11,200					3
Senior Test Engineer	160	\$22,400					3
Test Engineer	640	\$89,600					3
Superintendent	160	\$22,400					3
Plant Engineer	160	\$22,400					3
Administrative Professionals	32	\$4,480					3
Technical Specialist	320	\$44,800					3
Maintenance	640	\$89,600					3
Operators	960	\$134,400					3
IT	160	\$22,400					3
QA	160	\$22,400					3
ESH	160	\$22,400					3
1							
Confidence Level	low 1	2	3	4	5 high con		

	WORK	BREAKDOWN WBS ELEN	N STRUCTURI MENT DEFINIT		ARY .			
1. PROJECT TITI	_E/PARTICIPANT					2. Date of	Prepara	tion
NGNP CTF / ARE	:VA						2/2009	
	4. WBS Element Title							
1.4.4	Readiness Assessment  6. Revision No.					7 Royi	sion Dat	-
o. Iliuex Lille No.	Rev. 0					7. 130	Sion Dat	
3. Work Stateme								
Nork to be done:	Perform CTF Internal Readine	ess Assessment.						
one month to close o	Assumed one month for readine corrective actions.	ess review (interna	l preparation, faci	lity inspection,	review meetin	g, and comment	resolution	n) and
Risk Elements:								
O Penin of Fotim								
9. Basis of Estima	ate xperience with similar projects							
Methodology.	sperience with similar projects	5.						
10 F-4:								
10. Estimate Deta	111		\$	\$	\$	<u> </u>	1 \$	Con
D	escription of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi.
	t Test Loop Readiness				,			
Principal Engine		320	\$44,800					3
Senior Engineer		500	\$70,000					3
Engineer		500	\$70,000				4	3
Senior Operator		500	\$70,000				+	3
Administrative P	roressionais	120	\$16,800					3
							<b>+</b>	·
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Confidence Level			2	3	4	5 high con		

	WORK	BREAKDOWN	N STRUCTUR	E DICTIONA	RY			_
		WBS ELEM	MENT DEFINIT	TION				
1. PROJECT TITL	E/DADTICIDANT					2. Date of	Dropora	tion
NGNP CTF / ARE							2/2009	ition
3. WBS Number	4. WBS Element Title							
1.4.5	Operational Readiness Rev	iew						
5. Index Line No.	Rev. 0					7. Revi	ision Dat	te
8. Work Statemer	nt							
	Provide support for Contracto							
	ation of the readiness of corr							
	and organizations to begin					ails associated	with	
turning the facility of	over to the user, including fin	al startup, testing	and balancing	mechanical sy	stems.			
Key Assumptions:	The CTF is not a nuclear or a H	igh Hazard Facility	and therefore a r	modified ORR v	vill be perform	ed.		
Risk Elements:								
				8				
9. Basis of Estima	ite							
Methodology: Ex	perience with similar project	S.						
								_
10. Estimate Deta	il		5	5 1	- 5		1 5	Con
De	escription of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	
Assess 1 & 30MWt	Test Loop Readiness							
Principal Engine	er	800	\$112,000					3
Senior Engineer		1250	\$175,000					3
Engineer		1250 1250	\$175,000				_	3
Senior Operator Administrative Pr	rofessionals	300	\$175,000 \$42,000				_	3
Administrative Fi	TOTESSIONAIS	300	Ψ42,000			1		Ť
								-
				-		1		
							+	
						1	_	
							-	
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							_	-
						-	-	-
						-	+	
Confidence Level								_
How good is the basi	is of estimate	low 1	2	3	4	5 high con	fidence	

WORK BREAKDOWN STRUCTURE DICTIONARY	Y
WRS ELEMENT DEFINITION	

. PROJECT TITLE/PARTICIPANT		2. Date of Preparation
NGNP CTF / AREVA	<b>\</b>	2/12/2009
3. WBS Number 1.5.1	4. WBS Element Title CTF Project Management Plan	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

Work to be done: Fundamental project management principles provide a framework for successful project execution and assuring compliance with DOE O 413.1A. A key element in establishing those principles is the Project Management Plan. This task is to develop, issue, and maintain the CTF Project Management Plan. It includes develop the Project Management Plan and have project team review comments and submit the plan for BEA review and approval, approve the plan, and implement it through the various project procedures. The plan will be updated as needed throughout the life of the project.

Key	<b>Assum</b>	ptions:
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Risk Elements:

## 9. Basis of Estimate

**Methodology**: Estimate based on experience from other projects.

## 10. Estimate Detail

	\$	2	2	\$	- \$	Con
Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi
	<u></u>					
24	\$3,360					4
24	\$3,360					4
360	\$50,400					4
24	\$3,360					4
80	\$11,200					4
24						4
40	\$5,600					4
24	\$3,360					4
24	\$3,360					4
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	24 360 24 80 24 40 24	Hours   Labor Cost	Hours   Labor Cost   Material	Hours   Labor Cost   Material   Equip.	Hours         Labor Cost         Material         Equip.         SubCon           24         \$3,360         \$3,360         \$360 <td>  Hours   Labor Cost   Material   Equip.   SubCon   ODCs    </td>	Hours   Labor Cost   Material   Equip.   SubCon   ODCs

Confidence Level

WORK BREAKDOWN S	TRUCTURE	DICTIONARY
WRS FI FMF	NT DEFINITION	ON

1. PROJECT TITLE/	PARTICIPANT		2. Date of Preparation
NGNP CTF / AREVA	<b>\</b>		2/12/2009
3. WBS Number	4. WBS Element Title		
1.5.2	Preliminary Schedule and Cost Es	stimates	
5. Index Line No.	6. Revision No.		7. Revision Date
	Rev. 0		

Work to be done: This task is to develop cost and schedule estimates from information generated during conceptual design of the 1MWt CTF and the 30MWt CTF facilities. As conceptual design proceeds design engineers will develop estimates for equipment costs and equipment delivery time frames as part of the design process (i.e. Cost engineers will not estimate equipment costs). Cost engineers will estimate the length of pipe and utility runs etc. based on preliminary building and equipment layouts and standard estimating tools such as MEANS. The deliverable is the schedule and cost estimates for the recommended alternative in the conceptual design report and other alternatives that may be presented in the conceptual design report as required by DOE 413.3a. A life-cycle cost estimate will be prepared for the recommended alternative and the other alternatives if that analysis is necessary to support the recommendation.

Key Assumptions: Due to the amount of pre-conceptual design already performed for CTF the alternative evaluation will be minimal. An allowance of 100 hours is assumed for evaluation of alternative cost and schedule.

Risk Elements:

Basis		

Methodology: Estimate based on experience from other projects

10. Estimate Detail

		\$	\$	\$	\$		Cor
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lv
Task #1							
Principal Engineer							
Senior Engineer							
Engineer							
Designer							
Project Manager							
Quality Assurance							
Administrative Professionals	200	\$28,000					3
Project Controls	1920	\$268,800					3
Records/Document Management							
ES&H							
						1	
						+	
						+	
						+	-
						-	
							-
						-	-

Confidence Level

How good is the basis of estimate

low 1

2

3

	WORK	BREAKDOWN STRUCTURE DIC WBS ELEMENT DEFINITION	TIONARY
1. PROJECT TITLE/			2. Date of Preparation 2/12/2009
3. WBS Number 1.5.3	4. WBS Element Title Baseline Schedule and Co	ost Estimates	
5. Index Line No.	6. Revision No. Rev. 0		7. Revision Date

Work to be done: This task is to develop the baseline cost estimate, resource loaded schedule, and project risk evaluation for the CTF facility as required by DOE 413.3a to support the submittal for CD-2/3A and 3B. Design engineers will provide equipment costs, procurement time frames, and detailed design drawings to the cost engineers who will use construction cost estimating standards such as MEANS to develop detailed estimates to complete the design and construction of the CTF facility. The baseline schedule will use the preliminary schedule as a starting point. The WBS structure and schedule of planned activities will be modified to align with the design phase plans. Cost estimates will be updated to reflect the current design and construction plans. Cost estimates and resources will be loaded into the schedule to determine whether leveling of resources and adjustment of the schedule is necessary and to establish a spending profile for the CTF. A risk evaluation will be performed and contingencies recommended. The deliverables for this task are: 1) a resource loaded schedule, 2) a spending profile by fiscal year, and 3) a risk evaluation and contingency recommendation.

Key Assumptions: Due to the extensive amount of pre-conceptual design effort, the design and associated cost are presumed to be well understood. Design and construction of the 1MWt and 30MWt

loops will be concurrent, co-located, and managed as a single project, requiring a single CD-1, CD-2/3a, CD-3b, and CD4 for the combined test loops.

Risk Elements:

#### 9. Basis of Estimate

Methodology: Estimate based on experience from other projects.

10. Estimate Detail

How good is the basis of estimate

Estimate Detail		\$	\$	\$	\$	\$	Cor
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lv
Task #1							
Principal Engineer		•					
Senior Engineer	400	\$56,000					3
Engineer							
Designer							
Project Manager							I
Quality Assurance							
Administrative Professionals	576	\$80,640					3
Project Controls	5760	\$806,400			\$15,000		;
Records/Document Management							
ES&H							
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nfidence Level							L

55 of 60

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3

5 high confidence

low 1

WORK	<b>BREAKDOWN</b>	<b>STRUCTURE</b>	DICTIONARY
	WRS FLEM	ENT DEFINITI	ON

1. PROJECT TITLE/	PARTICIPANT	2. Date of Preparation
NGNP CTF / AREVA		2/12/2009
3. WBS Number	4. WBS Element Title	
1.5.5	CTF Project QA Program	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

Work to be done: Fundamental project management principles provide a framework for successful project execution and assuring compliance with DOE O 413.1A. A key element in establishing those principles is the Project Quality Assurance Plan. The CTF Facility and Test Loops themselves are not considered quality affecting. The quality level of test data collected from the operation of the CTF will vary depending on the test, test purpose, and how the test data will be used. The test data collection system will use appropriately calibrated M&TE to ensure the validity of the data. A Project QA Plan was developed during the preparation for the Initial Conceptual Design Phase. This activity is to maintain, update, and implement as necessary through the project life.

Kov	Assumptions:	The CTF Facility	and Test I	oons are not	quality affecting
nev	ASSUMBLIONS:	THE CIF FACILITY	and rest i	Loops are not	duality allecting.

Risk Elements:

#### 9. Basis of Estimate

Methodology: Estimate based on experience from other projects.

# 10. Estimate Detail

		\$	\$	\$	\$	- \$	Conf
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	LvI.
Task #1							
Principal Engineer		1.60					
Senior Engineer							
Engineer							
Designer							
Project Manager							
Quality Assurance	600	\$84,000					4
Administrative Professionals	160	\$22,400					4
Project Controls							
Records/Document Management							
ES&H							
						1	

#### Confidence Level

<b>WORK BREAKDOWN STRU</b>	ICTURE DICTIONARY
WRS ELEMENT D	FEINITION

1. PROJECT TITLE/		2. Date of Preparation
NGNP CTF / AREVA		2/12/2009
3. WBS Number 1.5.6	4. WBS Element Title CTF Project Management Reviews and Reports	
5. Index Line No.	6. Revision No. Rev. 0	7. Revision Date

Work to be done: A primary deliverable of the Conceptual Design Phase is the Conceptual Design Report. This task includes the collection of the technical design, schedule, and cost data to develop the Conceptual Design Report. It includes the development of the report, internal project review and comment resolution, submittal to BEA for comment, resolution of BEA comments, and final approval and submittal of the report. Support for Project Review/Interface Meetings for the 50% and 90% design reviews.

Key Assumptions: The CTF Facility and Test Loops are not quality affecting, Project Duration is 82 Months.

Risk Elements:

# 9. Basis of Estimate

Methodology: Estimate based on experience from other projects.

10. Estimate Detail

		\$	\$	2	\$	2	Con
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi
Prepare CD Report				•			
Principal Engineer	120	\$16,800					4
Senior Engineer	120	\$16,800					4
Engineer	300	\$42,000					4
Designer	160	\$22,400					4
Project Manager							
Quality Assurance	24	\$3,360					4
Administrative Professionals	160	\$22,400					4
Project Controls	120	\$16,800					4
Records/Document Management	24	\$3,360					4
ES&H	24	\$3,360					4
Procurement	24	\$3,360					4
Travel for 50 & 90% review meetings						\$58,000	4
						<u> </u>	
	<u> </u>						
nfidence Level							

WORK	<b>BREAKDOWN</b>	<b>STRUCTURE</b>	DICTIONARY
	WRS FI FM	ENT DEFINITI	ON

1. PROJECT TITLE/	PARTICIPANT	2. Date of Preparation
NGNP CTF / AREVA		2/12/2009
3. WBS Number	4. WBS Element Title	
1.5.7	CTF Project Support	
5. Index Line No.	6. Revision No.	7. Revision Date
	Rev. 0	

Work to be done: Fundamental project management principles provide a framework for successful project execution and assuring compliance with DOE O 413.1A.. The Project Management/Oversight activities establishes a core staff to provide oversight for the CTF design, construction, commissioning, and turnover. This task includes the following functions: ES&H, Project Controls, contract and subcontract management, project accounting/reporting, records/document management, and Quality Assurance. This activity includes: (1) Development and implementation of the Project Management, ISMS, and Quality Assurance Plans; (2) Review Procurement Packages and Contracts; (3) Review of weekly/monthly contractor status reports, attend contractor meetings, and administer contracts; (4) Review and approval of contractor invoices; (5) Development of Weekly/Monthly Status reports, invoices, attend periodic project meetings; (6) Selection, approval, and oversight of contractors. This also captures the Project Level Travel and ODCs.

Key Assumptions: Project Duration is 82 Months; Construction Duration is 43 Months.

#### Risk Elements:

## 9. Basis of Estimate

Methodology: Estimate based on experience from other projects.

#### 10. Estimate Detail

		\$	\$	\$	\$	\$	Con
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvi
Task #1							
Principal Engineer		•					
Senior Engineer							
Engineer							
Designer							
Project Manager	13440	\$1,881,600					3
Quality Assurance	3360	\$470,400					3
Administrative Professionals	13440	\$1,881,600					3
Project Controls	13440	\$1,881,600					3
Records/Document Management	13440	\$1,881,600					3
ES&H	6720	\$940,800					3
Procurement	6720	\$940,800					3
IT	6720	\$940,800					3
Travel						\$1,062,600	3
						1	
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nfidence Level		L					_

2 5 high confidence low 1 How good is the basis of estimate

	WORK		N STRUCTUF MENT DEFIN		ARY			
1. PROJECT TITLE/P.	ARTICIPANT	<u> </u>					of Preparati	ion
NGNP CTF / AREVA	T. 1100 E					2/	12/2009	
3. WBS Number 1.5.8	4. WBS Element Title Construct - CTF Oversi							
5. Index Line No.	6. Revision No.			100		7. Re	vision Date	
l mack and its	Rev. 0							
8. Work Statement								
engineering/design cha Records/Document Ma	ng the construction phase thange control, Construction Nagement, and Information	Management, E Technology.	S&H, QA, Proje	ct Controls, A	dministrative	Support, Proc	urement,	
remaining will be local pe	c Construction Phase is 43 Mo rsonnel.	ntns, No Overum	le/packsniπ is ass	umea, o peop	e will be on te	mporary living e.	xpenses. The	
Risk Elements: NGNP r	mission, priorities, and funding	are revised ann	ually. Severe wea	ather.				
9. Basis of Estimate								-
methodology. Estima	ate based on experience fro	ini previous pro	j <del>e</del> cis.					
10. Estimate Detail								
Desci	ription of work	Hours	\$ Labor Cost	\$ Material	\$ Equip.	\$ SubCon	ODCs	Lvi.
Principal Engineer								
Senior Engineer		6720	\$940,800				1	3
Engineer (3)		20160	\$2,822,400				T	3
Designer		6720	\$940,800					3
Construction Manager		6720	\$940,800					3
Construction Superinte		20160	\$2,822,400					3
Administrative Profession		13440	\$1,881,600					3
Records/Document Mana	agement	6720	\$940,800		_			3
ES&H (2)		13440	\$1,881,600					3
QA IT		1680 6720	\$235,200 \$940,800					3
Procurement (2)		13440	\$1,881,600					3
Project Controls		6720	\$940,800					3
Temporary living expense							\$824,040	3
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							<u> </u>	
Confidence Level								

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low 1

How good is the basis of estimate

3

<b>WORK BREAKDOWN</b>	<b>STRUCTURE</b>	<b>DICTIONARY</b>
WRS FLEM	ENT DEFINITI	ON

1. PROJECT TITLE/F	2. Date of Preparation		
NGNP CTF / AREVA			2/12/2009
3. WBS Number	4. WBS Element Title		
1.6	Operate - CTF		
5. Index Line No.	6. Revision No.		7. Revision Date
	Rev. 0		

Work to be done: Perform NGNP test activities using the 1MWt and 30MWt Test Loops

Key Assumptions: It is assumed that programmatic changes and revisions to the NGNP TDRMs and test plans do not have a significant impact on the CTF Mission. It is assumed that utilization of the 30 MW test loop is front loaded with demonstration tests of critical long lead items.

Risk Elements: NGNP mission needs, priorities, and funding are revised annually.

# 9. Basis of Estimate

Methodology: Experience with similar projects.

## 10. Estimate Detail

	1	\$	\$	\$	\$	\$	Cont
Description of work	Hours	Labor Cost	Material	Equip.	SubCon	ODCs	Lvl.
Operate FY1 [Activity 20P1640]							_
Facility Manager	2000	\$280,000					2
Superintendent (2)	4000	\$560,000					2
Plant Engineer	2000	\$280,000					2
Senior Test Engineer	2000	\$280,000					2
Test Engineer (8)	16000	\$2,240,000					2
Tech Specialist (4)	8000	\$1,120,000					2
Maintenance (8)	16000	\$2,240,000					2
Operators (6)	12000	\$1,680,000					2
Custodial (4)	8000	\$1,120,000					2
ES&H	2000	\$280,000					2
QA	2000	\$280,000					2
IT	4000	\$560,000					2
Administrative	4000	\$560,000					2
Equipment, Computers, Calibration Services						\$6,950,000	2
FY1 Total \$18,430,000							
Operate FY2 [Activity 2OP1650]		\$11,480,000				\$6,950,000	2
Operate FY3 [Activity 2OP1660]		\$11,480,000				\$6,950,000	2
Operate FY4 [Activity 2OP1670]		\$11,480,000				\$6,950,000	2
Operate FY5 [Activity 2OP1680]		\$11,480,000				\$6,950,000	2
							1
							1

Confidence Level