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1.0 Executive Summary

A. Project Objective

The principal objective of this project is to develop materials technology for use in ultrasupercritical (USC) plant boilers capable of operating with 760°C (1400°F), 35 MPa (5000 psi) steam.

B. Background and Relevance

In the 21st century, the world faces the critical challenge of providing abundant, cheap electricity to meet the needs of a growing global population while at the same time preserving environmental values. Most studies of this issue conclude that a robust portfolio of generation technologies and fuels should be developed to assure that the United States will have adequate electricity supplies in a variety of possible future scenarios.

The use of coal for electricity generation poses a unique set of challenges. On the one hand, coal is plentiful and available at low cost in much of the world, notably in the U.S., China, and India. Countries with large coal reserves will want to develop them to foster economic growth and energy security. On the other hand, traditional methods of coal combustion emit pollutants and CO₂ at high levels relative to other generation options. Maintaining coal as a generation option in the 21st century will require methods for addressing these environmental issues.

This project has established a government/industry consortium to undertake a five-year effort to evaluate and develop advanced materials that allow the use of advanced steam cycles in coal-based power plants. These advanced cycles, with steam temperatures up to 760°C, will increase the efficiency of coal-fired boilers from an average of 35% efficiency (current domestic fleet) to approximately 52%. This efficiency increase will enable coal-fired power plants to generate electricity at competitive rates (irrespective of fuel costs) while reducing CO₂ and other fuel-related emissions by as much as 29%.

Success in achieving these objectives will support a number of broader goals. First, from a national perspective, the program will identify advanced materials that will make it possible to maintain a cost-competitive, environmentally-acceptable coal-based electric generation option. High sulfur coals will specifically benefit in this respect by having these advanced materials evaluated in high-sulfur coal firing conditions and from the significant reductions in waste generation inherent in the increased operational efficiency. Second, from a national perspective, the results of this program will enable domestic boiler manufacturers to successfully compete in world markets for building high-efficiency coal-fired power plants.

The project is based on an R&D plan developed by the Electric Power Research Institute (EPRI) that supplements the recommendations of several DOE workshops on the subject of advanced materials, and DOE's Vision 21. In view of the variety of skills and expertise required for the successful completion of the proposed work, a consortium that includes EPRI and the major domestic boiler

manufacturers (Alstom Power, Babcock and Wilcox (a division of McDermott Technologies Inc.), Foster Wheeler and Babcock Borsig Power) has been developed.

C. Project Tasks

The project objective is expected to be achieved through 9 tasks as listed below:

Task 1.	Conceptual Design and Economic Analysis
Task 2.	Mechanical Properties of Advanced Alloys
Task 3.	Oxidation Resistance
Task 4.	Fireside Corrosion Resistance
Task 5.	Welding Review
Task 6.	Fabricability
Task 7:	Coatings
Task 8:	Design Data and Rules
Task 9:	Project Integration and Management

D. Major Accomplishments During the Quarter

- A kick-off meeting was held in Chicago on October 22. Complete management and reporting structure was established. To lead each task, a task leader was appointed to provide overall technical direction to the project, a Project Steering Committee (PSC) was established. To provide management support, a Project Management Oversight Committee (PMOC) was established. Membership to these committees and their roles were defined.
- Task-wise and company-wise budget allocations and FY2002 budgets were assigned.
- Milestone plans were established commensurate with the budgets.
- Subcontracts are now in place between EIO and all but two of the consortium members. Both remaining subcontracts are in the final review stages at their respective firm's legal departments.
- A meeting of the Technical Steering Committee took place in late November, 2001. This meeting, conducted in Pittsburgh, was attended by each of the consortium members and representatives of the Department of Energy/NETL and Oak Ridge National Laboratory. The meeting was conducted to review the revised program funding profile and to define alternative program schedules to accommodate the funding reduction by delaying the start of sub-tasks without extending the overall scheduled completion date of the program.
- Requests for material type, size, quantity, and product form that will be needed by each of the consortium members for their respective Tasks have been made. This effort is being coordinated through EPRI to allow for possible cost savings in material procurement by consolidating orders for the needed materials into larger lot sizes than the alternative of requiring each consortium member to order their own material. Another benefit from consolidating the material purchases is that any lot to lot differences in purchased materials will be eliminated.

Several alloy vendors were invited to make presentations to the Project Steering Committee. For initial study, Ni base alloy Haynes 230, Inco 740 and Marcoalloy (modified Inco 617) have been identified as candidates. Minutes of the Pittsburgh meeting was prepared and sent to all attendees.

- Several state of the art review concerning advanced materials and coatings are nearly completed and are expected to be issued as draft reports during the next quarter.
- All consortium members reviewed and commented on the OCDO Royalty/Payment Agreement. The agreement was subsequently updated to include input from all consortium members. EIO submitted the consortium “strawman” to OCDO on December 18, 2001 for consideration. OCDO forwarded the document to their legal counsel who are presently reviewing the proposed document.

E. Plans for the Next Quarter

It is anticipated that the following work will be completed during the next quarter:

- Issue of draft reports on alloy selection (by B&W and ORNL) and coating technology (by Alstom).
- Completion of work on Task 1 conceptual design and initiation of work on the economic analysis.
- Finalization of material needs and issuing purchase order(s).
- Finalization of Royalty Repayment Agreement.
- Finalization of remaining two subcontracts.
- Technical efforts are continuing.

F. Issues

Reduction in funding has resulted in deferring some of the tasks. The rescheduling and reorganization of the milestones was done at considerable expense of time. Delays in providing input needed to procure materials has set back the test programs slightly. Availability of some of the advanced alloys is required product forms continue to be of concern.

2.0 Taskwise Status

Task 1: Conceptual Design and Economic Analysis (Task lead EPRI)

- Objective: The objective of Task 1 is to specify the temperature/pressure distribution for 760°C/35 MPa (1400°F/5000 psi). Steam inlet conditions so that the data needs and the range of test parameters be identified and the economic of material selection established.
- Results: The scope of work was defined in detail and assignments were made to B&W and Alstom. Bill Ablett, retired senior VP from Foster Wheeler was lined up as a third party reviewer for the task. George Booras of EPRI was identified as the resource person for the economic analysis.
- Task Schedule and Concerns: The task is on schedule. Extensive discussions were needed before defining the scope of work commensurate with the meager budget. Only a simplified conceptual design and economic analysis will be developed using existing models and data.
- Plans for Next Quarter: The conceptual design will be essentially completed. The economic analysis work will be initiated. B&W will complete a "white paper" on candidate materials. Materials requirements will be defined and procurement completed.

Task 2: Mechanical Properties of Advanced Alloys (ORNL under separate DOE contract, but coordinated through this contract)

- Objective: The objective of this task is to define candidate materials, and test matrices and to evaluate the relevant mechanical and microstructural properties.
- Results:

Task 2A: Assessment of the Alloy Performance Requirements: This assessment will focus on performance needed for boiler service in the temperature range of 1200°F (649°C) to 1600°F (871°C). A target date of February 15 was set for the first draft of this report. At least four authors from the ORNL will be involved. The general outline and focus have been identified.

Task 2B: Detailed Test Plan: The databases for the alloys identified at the Chicago meeting of the USC Project Team are being reviewed. We expect that a draft of the detailed testing program for Task 2 will be prepared in February 2002.

Task 2C: Long Term Creep Strength: Currently, 40 creep machines have been assigned to Task 2. Of these, 20 are in use. The other 20 machines are in need for refurbishment. This refurbishment involves the installation of a data acquisition system including load and strain sensors on each machine. Load cells have been ordered and an extension measuring system in under evaluation. Material for extensometers has been received.

Task 2D: Microstructural Analysis: Efforts have started to place a subcontract with the University of Cincinnati for microstructural evaluations. The target date for this subcontract is June, 2002.

Task 2E: Assessment of Creep-Fatigue Properties: Four fatigue-testing systems have been assigned to explore creep-fatigue issues. Two machines for use on austenitic (nickel-base alloys) will involve induction heating procedures. Two machines to be used for ferritic alloys are being modified to replace the induction units by resistance furnaces to eliminate magneto-mechanical effects on temperature distributions and stress fields.

Task 2F: Modeling of Weld Joints: Four heavy load creep testing systems have been allocated for testing of weld joints. Refurbishment of equipment is underway. One fatigue testing system has been allocated for weldment testing but no action has been taken to refurbish the machine.

Task 2G: Study of Accelerated Testing Methods: One electro-hydraulic testing machine is being refurbished to perform relaxation testing. Two modified creep machines are being recommissioned to perform longer-time relaxation tests.

Task 2H: Model Validation: Two creep machines normally used for crack growth work have been assigned to model validation. The ability of potential drop methods to examine crack initiation in notched specimens will be checked.

- Task schedule and Concerns: The task is on schedule. No concerns at this time.
- Plans for Next Quarter: The draft reports on candidate alloys and test matrices will be completed.

Task 3: Steamside Oxidation Resistance (Task lead Babcock & Wilcox)

The objective of the task is to evaluate the relative oxidation resistance of various advanced alloys and to identify the upper temperature limit for use of the alloy.

Task 3A Autoclave Testing

- Objective: Four steamside oxidation tests will be performed on commercially available and developmental materials at temperatures between 650°C and 900°C (1202°F - 1652°F).
- Results:

Preliminary discussions were held regarding test system configuration and the size and number of specimens that would be tested in each run. It is presently anticipated that the test system will consist of a pressure vessel (ratings as of yet undetermined) that will be placed inside of a furnace. It is also anticipated that the steam will be provided to the test vessel in a once-through manner at a slow feed rate (very low velocity).

Initial contact was made with Oak Ridge National Laboratory (ORNL) personnel involved in steamside oxidation testing. It is anticipated that a meeting between McDermott Technology, Inc.

(MTI) and ORNL will take place in January or February 2002 to insure that the testing that will be conducted at the two facilities will be complimentary with a minimum of overlap.

The number and size of the specimens that will be tested has not yet been determined. Two factors that will influence these decisions are: 1) the number of materials that will be available for test, and 2) the amount of space available in the test vessel. It is presently planned that one test system will be constructed; thus, the four test runs will be performed consecutively. In order to complete all test runs within the contract schedule, it is imperative that the test materials for the first test run (650°C [1202°F]), be available at MTI no later than December 2002. Since the test runs will involve the removal of specimens at timed intervals (after 1000, 2000 and 4000 hours), enough space must be available in the test vessel to contain triplicates from each test material. If the tests at MTI will be performed at high pressures, then the test vessel wall thickness will increase, leaving less room for specimens.

- Task Schedule and Concerns: The subtask is on schedule.
- Plans for Next Quarter: Between January and March, 2002, the environmental conditions for the first test run (temperature and pressure) will be finalized. Also the test system will be designed and materials for the test system will be ordered. Based on the test system design, the number and size of the specimens will be determined.

Task 3B Coating Tests

- Objective: Coated specimens for steamside oxidation testing will be prepared in conjunction with Task 7 and evaluated after testing.
- Results: No progress.
- Task Schedule and Concerns: In order to include coated specimens in the first steamside oxidation test run (650°C [1202°F]), the coated materials must be available for specimen preparation no later than December 2002.
- Plans for Next Quarter: Specimen size/number requirements for steamside oxidation testing will be communicated to Task 7 personnel when the information becomes available.

Task 3C Assessment of Temperature

- Objective: Based on the steamside oxidation test results, the practical temperature limits for the materials tested will be determined.
- Results: No progress.
- Task Schedule and Concerns: Progress will be possible only after results from the steamside oxidation tests are available (GFY2003).

- Plans for Next Quarter: None.

Task 3D Review of Available Information & Reporting

- Objective: Available steamside oxidation literature pertaining to materials and environmental conditions of interest will be reviewed. Project status updates will be prepared and status meetings will be attended as required.
- Results: Preliminary portions of the literature review have been conducted. Also, a comprehensive review paper on high temperature steam oxidation written by ORNL for the CORROSION'02 conference was reviewed.
- Task Schedule and Concerns: On schedule.
- Plans for Next Quarter: The literature review will be completed and a draft report issued.

Task 3E Conduct Experimental Exposures

- Objective: Model Fe-Cr alloys will be fabricated. Specimens will be prepared for steamside oxidation testing.
- Results: ORNL personnel indicated that they, too, were considering the testing of model Fe-Cr alloys. Equipment is being modified at ORNL to permit steam testing. Efforts need to be coordinated between MTI and ORNL on the fabrication of these model alloys.
- Task Schedule and Concerns: On schedule.
- Plans for Next Quarter: Discussions with ORNL will continue to determine compositions and quantities of model Fe-Cr alloys that will be fabricated. It is anticipated that melting/processing of these alloys will also begin by the end of March 2002.

Task 3F Characterization

- Objective: Samples of the model Fe-Cr alloys fabricated in Task 3E will be characterized before and after steamside oxidation testing using metallographic and electron optic techniques.
- Results: No progress.
- Task Schedule and Concerns: Progress will be possible only after the model Fe-Cr alloys are fabricated (anticipated to be 3rd or 4th quarter of GFY2002).
- Plans for Next Quarter: None.

Task 3G Data Analysis and Coordination

- Objective: The steamside oxidation results will be evaluated to determine the effects of material properties and environmental factors on oxidation behavior.
- Results: No progress.
- Task Schedule and Concerns: Progress will be possible only after the steamside oxidation tests have been completed (GFY2006).
- Plans for Next Quarter: None.

Task 4: Fireside Corrosion (Task lead Foster wheeler)

The objective of the task is to evaluate the relative resistance of various advanced alloys to fireside corrosion.

Task 4A Laboratory Testing

- Objective: To perform laboratory tests on candidate alloys.
- Results: The materials to test have not been finalized and therefore the laboratory tests have not begun. The apparatus and test plan are being reviewed to begin material procurement. The milestone chart was reviewed and any changes were made.
- Task Schedule and Concerns: Candidate materials need to be identified and procured.
- Plans for Next Quarter: None.

Task 4B Corrosion Probe Testing in Utility Boilers

- Objective: to install corrosion probes of various alloys at different temperatures in boilers.
- Results: Previous corrosion probe designs are being reviewed in light of the higher test temperatures to determine the required probe dimensions. This information will be utilized for probe material procurement. The milestone chart was reviewed and any changes were made.
- Task Schedule and concerns: Identification of correct tubing diameters is crucial before procurement can be specified.
- Plan for Next Quarter: Foster Wheeler will define tube dimensions for probes.

Task 4C Steam Loop Testing

- Objective: To install steam loops and evaluate candidate alloys in boilers for fireside corrosion.

- Results: Mc Dermott has confirmed, Reliant Niles plant, in Niles, Ohio will be one of the test sites for the test loop. They intend to piggyback onto the DOE-sponsored loop testing presently being performed in that plant, with the loop needing to be ready for insertion by the end of calendar year 2002. Some auxiliary equipment (e.g. valves) that is needed to make the transition to our loops have been identified and placed on order. Procurement has begun for the small attachment components to be used on the test loop. The tube test material sizes have been established. A literature review of potential alloys to be included in the loop was begun and the first choice test materials was decided and procurement begun.

An evaluation of milestone modification and funding requirements was initiated and it is very critical that the schedule not slip, as the loop must be installed at a specific boiler outage.

- Task Schedule and Concerns: Availability of raw materials in the proper sizes is still a concern.
- Plan for Next Quarter: Continue work on material procurement.

Task 5 Welding Development

- Objective: To define weld metal choices for candidate materials; to evaluate weldability issues; to establish acceptable welding procedures and practices; to evaluate the effects of manufacturing heat treatments and preheat and post weld heat treatments on weldment integrity and properties; to produce samples needed to determine the properties of candidate ultrasupercritical alloy welds and weldments, including the dissimilar metal weld joint between the various types of material (actual mechanical and property testing will be performed under Task 2).
- Results: The Task 5 efforts were concentrated on the details of starting the program. These included: the internal organizations within the participating companies were created and staffing assignments were made. Projected spending plans were developed and work scope details were laid out to the extent possible at this point in the program. Estimates were made regarding the quantities of base materials required for the development work and for the production of test specimens.
- Task Schedule and Concerns: On schedule. Availability of suitable filler metal is a concern.
- Plans for Next Quarter: Identification of the specific materials that will be studied in the program and initial procurement efforts for these materials; the selection of the welding processes to be studied will be started; locating sources for filler metals capable of joining the base materials and appropriate for the welding processes will be started.

Task 6: Fabricability (Task lead Babcock & Wilcox)

The objectives of Task 6 are to understand the effects of fabrication on the properties and characteristics of candidate alloys for USC power plants and to establish practical, effective guidelines for producing boiler components from these materials.

Task 6A Fabrication Trials: Superheater Components

- Objective: Four of the most promising ferritic and austenitic alloys for USC superheater applications will be evaluated in fabrication trials simulating commercial boiler manufacturing operations. One of each alloy will be assigned to each of the four Consortium manufacturers for fabrication trials.
- Results:
Activities in this task concentrated on the details of starting the program. Internal organizational structures at each of the Consortium member companies were created and staffing assignments were made. Projected spending plans were developed and workscope details were established to the extent possible at this point in the program. Preliminary test material needs and budget allocation for these materials were estimated and transmitted to EPRI.

Preliminary plans and discussions concerning the fabrication trials of candidate high temperature alloys for USC power generation were held. For the initial trials, it is anticipated that conventional processing procedures will be utilized for processes such as bending and rolling, swaging, upsetting, machining, drilling, and boring. Modifications to the procedures will be developed, as required, to adjust to the unique characteristics and limitations of the materials involved.

Preliminary discussions with personnel from Oak Ridge National Laboratory (ORNL) were held to address the potential effects of hot working and cold working on the long-term stability of candidate alloys operating at USC system design temperatures.

Work is nearing completion on a study being conducted by ORNL summarizing the ferritic and austenitic/superalloy materials that are the best candidates for USC boiler design. This report, which includes information on recently developed high temperature alloys, will be supplied to EPRI and Consortium members in February and will be used as a reference for selection of materials and activities in Task 6.

- Task Schedule and Concerns: Based on budget shortfalls for the first plan year, work on this Task has been deferred until the next plan year except for planning, and activities associated with identifying and procuring the raw materials needed.
- Plans for Next Quarter: Candidate alloys will be selected. Available information on the forming and machining characteristics of candidate alloys will be reviewed during the first quarter of 2002. Upon joint selection of candidate alloys by Consortium members, procurement of these materials for this project task will also be initiated.

Task 6B Fabrication Trials: Thick-Walled Components

- Objective: Four of the most promising ferritic and austenitic alloys for USC piping and header applications will be evaluated in fabrication trials simulating thick-walled commercial boiler manufacturing operations.

- **Results:**
Activities concentrated on the details of starting the program. Internal organizational structures and staffing assignments were made. Projected spending plans were developed and workscope details were established to the extent possible at this point in the program. Preliminary test material needs and budget allocation for these materials were estimated and transmitted to EPRI.

The ORNL study and report summarizing candidate materials for USC boiler design will also be utilized in the selection of materials for Task 6B. Activities in this task, which focus on the production of thick-wall components, include procurement of materials, pipe bending and plate forming trials, header fabrication (including welding and NDE), and metallurgical testing.

Concurrent with the activities of Task 6A, preliminary plans concerning the fabrication trials of candidate high temperature alloys for thick-wall components in USC power systems were discussed with each manufacturing facility. As in Task 6A, conventional processing procedures will first be utilized for processes such as bending and rolling, machining, drilling, and boring. Modifications to the procedures will be developed to adjust to the unique characteristics and limitations of these materials.

- **Task Schedule and Concerns:** The task is on schedule.
- **Plans for Next Quarter:** The alloys will be selected this coming quarter. Efforts will begin to collect and review available information on the welding, heat treatment, forming and machining characteristics of candidate alloys. Upon joint selection of candidate alloys by the Consortium members, procurement of these materials for this project task will be initiated.

Task 6C Fabrication Trials: New Alloys and Thermomechanical Treatments

- **Objective:** Newly developed high temperature alloys intended for use in advanced USC power plants will be evaluated in fabrication trials simulating commercial boiler manufacturing operations.
- **Results:** Activities in this task, focus on new materials that may become known and available after initiation of the early stages of this program. This subtask will allow for collection of information, and materials that may then be subjected to production trials of methods applicable to the fabrication of both superheaters and thick-wall components, and will include procurement of materials, and metallurgical testing.
- **Task Schedule and Concerns:** There was no activity this last quarter on this subtask as effort has been concentrated on identifying the initial eight alloys to be used in Subtask 6A and 6B activity.
- **Plans for Next Quarter:** Available information on new, recently developed alloys will be continuously surveyed during 2002.

Task 7: Coatings (Task lead Alstom)

The major objectives for Task 7 Coatings are: Review state-of-the-art of coating technology and identify development needs; Develop coating manufacturing techniques, which can provide corrosion/erosion protection for components in USC boilers, cost effectively; Establish manufacturing ; Provide coated samples for corrosion and oxidation testing in the laboratory and “in the field”.

Task 7A Detailed Study of Current State of the Art

- Objective: To perform an SOA review of coatings.
- Results: Work efforts on this task were started this quarter. Keyword literature reviews were initiated, including the following topics:
 1. Materials and coatings performance assessments in boiler applications,
 2. Diffusion Coatings,
 3. Oxidation of metals and alloys in steam environments,
 4. Oxidation of metals and alloys in environments typical of low-NO_x coal firing,
 5. Chromizing and Chromizing-Aluminizing,
 6. Iron aluminide in boiler applications
 7. Laser cladding
 8. D-gun technology

Lists of relevant citations were received and reviewed. Orders were placed for selected papers not currently in our possession. Collection of literature articles will continue and technical review started on the literature that has been collected to date.

- Task Schedule and concerns: No schedule.
- Plans for Next Quarter: Complete literature review and issue draft report.

Task 7E: Process Scale Up – Preliminary Trials

- Objective: Explore scaleup and perform trials.
- Results: Continued review of selected technical information on high temperature alloys and coatings. Discussed potential USC substrate alloys and compatible coatings with B&W personnel. Visited Praxair Surface Technologies (New Castle, PA) to discuss both laser cladding and plasma arc weld cladding of substrate alloys. Procured laser-clad specimens from Praxair for preliminary metallurgical analysis. Additionally, preliminary test material needs and budget allocation for these materials, as related to Task 7, were documented and transmitted to EPRI.
- Task Schedule and Concerns: Some concern is expressed on the need to select study alloys and begin procurement efforts to ensure that materials will be available when needed for testing.

- Plans for Next Quarter: Begin planning specific laser cladding trials at Praxair Surface Technologies; Begin planning preliminary chromizing coating trials and plasma arc weld cladding trials at MTI

No progress was made on other subtasks 7B - 7D.

Task 8: Design Data and Rules

No progress. Task deferred due to budget shortfall.

Task 9: Program Management and Integration (Task lead EIO, EPRI)

- Objective: The objective is to provide technical and administrative management support.
- Results: A kick-off meeting was held in Chicago on October 22, 2001. Complete management and reporting structure was established. To lead each task, a task leader was appointed. To provide overall technical direction to the project, a Project Steering Committee (PSC) was established. To provide management support, a Project Management Oversight Committee (PMOC) was established. Membership to these committees and their roles were defined.
- Task-wise and company-wise budget allocations and FY 2002 budgets were assigned.
- Subcontracts are now in place between EIO and all but two of the consortium members. Both remaining subcontracts are in the final review stages at their respective firm's legal departments.
- All consortium members reviewed and commented on the OCDO Royalty/Payment Agreement. The agreement was subsequently updated to include input from all consortium members. EIO submitted the consortium "strawman" to OCDO on December 18, 2001 for consideration. OCDO forwarded the document to their legal counsel who are presently reviewing the proposed document.
- Requests for material type, size, quantity, and product form that will be needed by each of the consortium members for their respective Tasks have been made. This effort is being coordinated through EPRI to allow for possible cost savings in material procurement by consolidating orders for the needed materials into larger lot sizes than the alternative of requiring each consortium member to order their own material. Another benefit from consolidating the material purchases is that any lot to lot differences in purchased materials will be eliminated.

Several alloy vendors were invited to make presentations to the Project Steering Committee. For initial study, Ni base alloy Haynes 230, INCO 740 and Marcoalloy (modified Inco 617) have been identified as candidates. Minutes of the Chicago meeting were prepared and sent to all attendees.

- ORNL is performing Task 2 (Mechanical Properties of Advanced Alloys) under a separate contract from DOE. EPRI is maintaining coordination with ORNL and is integrating their results with those from the present project.

- A meeting of the Technical Steering Committee took place in late November, 2001. This meeting, conducted in Pittsburgh, was attended by each of the consortium members and representatives of the Department of Energy/NETL and Oak Ridge National Laboratory. The meeting was conducted to review the revised program funding profile and to define alternative program schedules to accommodate the funding reduction by delaying the start of sub-tasks without extending the overall scheduled completion date of the program.
- Other management functions including communications, preparation of monthly reports, etc. are being carried out.
- Task Schedule and Concerns: Timely follow-up action items agreed upon by consortium members due to staff work load continues to be a concern. Once, all the subcontracts are in place and reporting routines are in place, this concern is expected to resolve itself.

Unexpected reductions in funding led to reschedule tasks and milestones and budgets – an exercise that took up a lot of time.

- Plans for Next Month: Continue project integration/management activities.

A meeting of all the task leaders and Project Steering Committee members will be organized in March to review progress.

Materials requirements will be finalized and procurement initiated. Royalty payment agreement and remaining subcontracts will be finalized. Technical efforts will continue.