Appendix V
Follow-on Effort Summary

PROPOSED FOLLOW-ON EFFORT(S) SUMMARY

CURRENT PROJECT INFORMATION

NUMBER: **500-98-040**

PROJECT NAME: **INTELLIGENT SOFTWARE AGENTS FOR CONTROL & SCHEDULING OF DISTRIBUTED ENERGY RESOURCES**

PROPOSED FOLLOW-ON PROJECT GOALS:

The technical & economic goals of the proposed follow-on effort are to:

- Update the *Smart**DER product specification based on feedback received during the Phase I effort as well as changes that have occurred in the California energy marketplace.
- Identify and enlist participation by one or more potential commercialization partners that will integrate *Smart**DER into their technology.
- Refine *Smart**DER technology to reflect changes in the product specification and to provide interfaces with commercialization partner(s) software.
- Complete a successful feasibility test assessment of *Smart**DER technology scheduling/controlling actual loads and/or distributed generation assets in the "real world" California marketplace.
- Negotiate with one or more partners for continued commercialization of *Smart**DER technology.

PROJECT RELEVANCY

Deregulation in California was in its formative stages in 1998 when the original Phase I effort was proposed. At that time it was already apparent that distributed energy resources (DER), such as distributed generation and curtailable loads could play a significant role in the marketplace. CADER (California Alliance for Distributed Energy Resources) summarized these benefits as follows:

- Improved system reliability, power quality, VAR control, and reduced reliance on must-run generation
- Reduced distribution system congestion, avoidance of distribution line losses and deferral of system upgrade/construction
- Customer cost reduction by direct displacement of load
- PX market clearing price (MCP) reduction (new DER reduces overall system demand which displaces the highest cost resource)

CADER projections indicated that DER technology could supply 20% - 40% of the estimated capacity that would be needed in California in the ensuing years to both replace retired generating plants and to meet increased loads.

It was also clear that while DER assets could play a significant role in this environment there

were significant barriers to the use of a technology that relies on control and scheduling of large numbers of distributed assets. The centralized decision and control paradigm employed in the electric power industry was ill suited to this task. Use of intelligent software agents with their ability to collaborate thus distributing the decision process is well suited to this task. The Phase I effort addressed the difficulty in introducing this new paradigm to the power industry by demonstrating the viability of this approach as well as providing demonstration software that could be used to facilitate technology transfer.

One need only look at the daily newspaper to understand the dynamic nature of the California marketplace. There is little question that integration of DER assets into the marketplace has become of paramount importance. In 1998 there were four basic avenues for DER interaction in the deregulated marketplace. First, DER assets could be used to offset site loads to provide cost savings associated with utility bill reduction. Secondly DER assets could be used in conjunction with UDC sponsored interruptible rates. Third, DER assets, if aggregated in sufficient numbers, could bid into the energy spot market run by the Cal PX. And fourth, aggregated DER assets could participate in the ancillary services auction run by the California ISO. Specific procedures and protocols for DER participation in the marketplace did not exist at the time the Phase I effort was proposed. A great deal of progress has been made in the development of these procedures and protocols since the Phase I effort began in May 1999. The energy spot market and the CalPX itself no longer exists[1] but there are now five separate programs, either in place or pending that will provide for participation by DER assets. These programs now include:

- CAISO ancillary services (AS) auction (Supplemental energy, ancillary services),
- UDC sponsored interruptible rate tariff participation,
- CAISO DRP (demand relief program) (new program for 2001),
- CAISO DLCP (discretionary load curtailment program) (new program for 2001),
- CEC Electricity Peak Load Efficiency Grant Program (AB970) (new program for 2001),

Each of these programs has different requirements for participation, varying communication procedures and different verification/reporting requirements. Coordination of DER assets, especially in cases where aggregation of large numbers of assets is necessary has increased in importance. Clearly our efforts to facilitate integration of DER assets into the California marketplace are now more important than ever.

EXISTING PROJECT BACKGROUND:

The overall goal of the existing PIER project is to demonstrate the viability of using intelligent software agents for control and scheduling of one or more distributed energy resources (e.g., distributed generation, energy storage, cogeneration, etc.) in a competitive market. An intelligent agent is a software-based device that acts on behalf of the user and has the ability to exploit knowledge, tolerate errors, reason with symbols, learn and reason in real time, and communicate in an appropriate language. This will facilitate insertion of intelligent software agent technology into the energy industry

[1] The CalPX announced that it would cease operations in April 2001.

with its associated benefits. One of these benefits is to facilitate the coordinated scheduling of multiple distributed energy resource assets. Another is to reduce the level of expertise needed to own and operate distributed energy resources, which will in turn, allow greater participation by owners of distributed energy resources in California's competitive energy industry.

Current Project Objectives

The technical & economic objectives of the existing project are to:

- Demonstrate how a prototype network of intelligent software agents can coordinate and schedule one or more distributed energy resources.
- Develop a demonstration package that will facilitate transfer of the project results into the private sector.
- Identify and initiate discussions with one or more potential partners who are willing and able to participate with commercialization of the DER*S agency.

Current Project Status

The existing project is nearing completion with all milestones and deliverables due for completion by February 2001. At that time, the following items will have been completed.

- A Project Final Report and Final Presentation/Software Demonstration will be provided.
- Demonstration software will be delivered to the Commission and will initially be made available to interested parties via a dedicated WebPage. This demonstration software will allow the user to set up one or more simulated sites with multiple DER assets, select a time period during 1999 and observe the software agents collaborating to achieve appropriate operating schedules.
- AESC will have identified 10 – 12 companies that have expressed an interest in moving forward in some fashion with intelligent agent technology.

PROPOSED FOLLOW-ON EFFORT DESCRIPTION:

Intelligent agent technology represents a fundamentally different way of addressing the DER asset-scheduling problem. Use of intelligent agent technology provides for a distributed decision-making solution where centralized decision making processes are currently being applied. This fundamental shift in thinking makes the job of transferring this technology into the private sector more difficult since it requires that potential users change the way that they view the problem (and solution). The existing project was structured to address this issue and once completed will provide the basic tools (e.g., Test report(s), Demonstration Software) needed to facilitate the transfer this technology.

The existing project brings this technology to a Stage 3 (Bench testing/proof of concept) level of development and also provides tools that facilitate acceptance of this new technology. The proposed follow-on efforts are structured to move this technology beyond Stage 3 and addresses issues related to selecting the correct path (and associated partners, if any) for moving this technology into the marketplace. The following sections describe the four activity areas[2] of the proposed follow-on effort.

[2] Additional information on specific tasks and associated deliverables within each activity area will be provided should the commission express an interest in pursuing the follow-on effort.

Activity Area 1: Review and Evaluate the Feedback from the Phase I Effort.

The current project (Phase I effort) provides for development and delivery of demonstration software to the Commission but does not provide for continued refinement and support after delivery. Successful use of this software in the field is very important to eventual acceptance of this technology since it represents the first exposure that many potential partners and end-users will have to this technology. During the Phase I effort we enlisted the support of a Virtual Evaluation Group of individuals and companies working in the energy industry. At the end of the Phase I effort we provided the demonstration software and supporting materials to the Virtual Evaluation Group for use and review. Therefore, the first task of this Phase II follow-on effort provides support for both use and testing of the demonstration software by the Virtual Evaluation Group and for distribution of the software to other interested parties during a 2 – 3 month trial period. At the conclusion of this trial period we will evaluate the feedback of the evaluation group as well as review changes in the energy marketplace and identify any product modifications or enhancements.

Activity Area 2: Identify Feasibility Field Test Participants

Eventual integration of *Smart**DER technology into the marketplace can take a number of paths. There are a large number of "players" involved in the DER asset marketplace (i.e., generation equipment manufacturers, energy management, system equipment manufacturers, communication software developers, etc.) that could have an interest in participating in further development and testing of *Smart**DER technology. AESC engaged several potential partners during the current project via the Virtual Evaluation Group and also attended a number of conferences (CADER) and meetings (CAISO) during the course of the project. Over a dozen companies expressed an interest in our technology as a result of these efforts. However, expressing an interest and actually committing to technology can be two different things. The problem lies in identifying which of the interested parties provides the best opportunity.

*Smart**DER technology and the agent-based decision making capability that it represents is one piece of a large and dynamic puzzle. Ultimately, for Smart*DER technology to make a significant impact on the energy marketplace it must be able to interface with a wide variety of equipment (i.e., generators, energy management systems, etc.) and external entities (i.e., schedule coordinators, CAISO, CalPX, etc.) each of which has its own interface requirements. The existing project was structured to provide proof of concept and to facilitate acceptance of this new technology by providing demonstration software. It would have been both cost prohibitive and premature to develop various equipment interfaces so this type of development was not included in the existing project.

The tasks associated with this activity area will expedite further development and subsequent insertion of this technology into the marketplace by:

- Identifying and selecting one or more field test participants for our technology that will improve our ability to quickly insert *Smart**DER technology into the marketplace.
- Expediting development of interface software allowing our technology to operate with a wide variety of equipment in the marketplace.

To facilitate further commercialization only field test partners committed to the advancement of this technology will be selected. In addition, identifying potential field test sites will be the responsibility of the potential partners that wish to participate and each participant will be responsible for identifying the interface requirements and associated modifications to make their software/hardware compatible

with *Smart**DER technology

Activity Area 3: Technology Refinement & Integration

The tasks associated with area of activity provide for refinement of *Smart**DER technology in response to product specification changes resulting from virtual evaluation group feedback and on observed changes in the energy marketplace. Interface refinements necessary for communication with field test partner products will be also be included.

Activity Area 4: Feasibility Field Test For Control of Actual Loads.

Basically, this area of activity provides for a feasibility field test of, the overall objective of which is to gather information on agent-based scheduling and aggregation of actual DER assets (distributed generation and curtailable loads) in a "real-world" dynamic environment. A large and successful feasibility field test will provide the necessary data on potential savings to entice customers to integrate this new technology into their operations. In addition, demonstrating feasibility will convince potential partners that a real and immediate need for this technology exists.

Activity Area 5: Project Management and Reporting

Tasks associated with this activity area encompass all of the management and reporting functions (i.e., kickoff meeting, monthly reporting, final report, etc.). AESC will continue to provide project management and reporting services as its matching contribution while other test participants (potential partners).

PROJECT BUDGET FUNDING AND SCHEDULE

It is anticipated that this effort would require 15 – 18 months to complete assuming one full year of field test activities (operation and monitoring). Should the Commission express an interest in pursuing the proposed effort, AESC will prepare formal descriptions and associated cost estimates for each task. However, as currently envisioned the Phase II Phase II follow-on will require less funding than the current project. Costs will vary depending feasibility field test duration and the number of participating sites. However for preliminary budgetary purposes it is anticipated that the cost of this effort will not exceed $500,000.