CPC Air-Blown Integrated Gasification
Combined Cycle Project

Quarterly Report
October - December 1992

January 1993

Work Performed Under Contract No.: DE-FC21-91MC27363

For
U.S. Department of Energy
Office of Fossil Energy
Morgantown Energy Technology Center
Morgantown, West Virginia

By
Tampa Electric Company
Tampa, Florida

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Morgantown Energy Technology Center
P.O. Box 880
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By
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P.O. Box 111
Tampa, Florida 33601-0111

January 1993

M A S T E R

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED
Nelson Rekos, Project Manager, for the U. S. Department of Energy (DOE) Clean Coal Branch welcomed the group and introduced the DOE project team members present.

Charles R. Black, Project Director, Tampa Electric Co. (TEC), introduced the TEC project team. He then gave an overview of the progress on the project including the status of the Site Certification Application, and the major contracts recently signed with General Electric and Texaco for the combined cycle engineered equipment package and gasification license, respectively. Mr. Black also discussed the Tampa Electric expansion plan and how this project is the first unit to be built on the Polk site.

Don Pless, Project Manager, TECO Power Services, discussed the project description. This covered the current cycle status of the unit: MW, Heat Rate, emissions, by-products and cycle optimization studies. It was also pointed out that due to current market conditions and expertise we will probably purchase the syngas coolers from foreign suppliers. The domestic bidders for this equipment either removed themselves from the competition or submitted unacceptable bids from a technical standpoint. A general arrangement drawing was shown and an artist rendering of the site and plant layout drawings were distributed. DOE requirements were covered relating to surveillance contracts, the advance patent waiver and Memo of Understanding with EPA.

Don Pless discussed the construction approach which has now changed from a turn key to a traditional approach of a construction manager and one or more general contractors. Major construction contracts will probably be broken-down by: site development, combustion turbine and combined cycle areas and the air separation unit.

The Project Team arrangement was covered showing the organizational structure of: the DOE IGCC portion, Tampa Electric non-IGCC, Texaco, General Electric, and GEESI with the A/E soon to be added. The various roles of the related project members were covered.
Mike Hegarty, Cost & Schedule, TECO Power Services, discussed the overall project cost and schedule. The combustion turbine commercial operation date is scheduled for 7/1/95 with the combined cycle commercial operation date of 7/1/96. A two year demonstration period will commence after IGCC commercial operation. Details of costs on a total project and DOE Envelope basis along with detailed schedule components were covered. Major cost variances to date were discussed. The major variances this year relate to contracts which were anticipated to be finalized mid 1992 but which are not executed. These include GEESI, the ASU and key vessels. Some of these contracts are almost in place and others are scheduled for the first quarter 1993.

Charles R. Black discussed the current status of the project as it relates to Tampa Electric. The internal Program Scope Approval (PSA) authorizing the project was approved in July, 1992. The Polk Project is the No. 1 priority project within our company. The addition of Polk Power Station will increase Tampa Electric's asset base by one-third. There has been a substantial increase in resource requirements within our organization impacting many departments in support of the project.

In the Regulatory area, the Tampa Electric Need Hearing (need for power) was approved in December, 1991 by the Florida Public Service Commission (FPSC). Intervenors at that time filed for the use of demand side management to offset the need for additional plant in service. The FPSC reapproved the TEC need for power with one intervenor now filing suit in the state supreme court with expected outcome in January, 1993. It is important to note that the supreme court traditionally leaves need issues to the FPSC and the court has not overturned a commission ruling on need for power. Tampa Electric's Price Change process was discussed. A major issue in that case is the treatment of construction work in progress (CWIP) from the Polk Project.

Dave Cowdrick, Tampa Electric's Production Project Leader, discussed the technical/engineering side of the project. Numerous project specifications, process flow diagrams, piping and instrument diagrams and other drawings have been reviewed and approved as part of the preliminary engineering process by Production Engineering. The A/E scope of work and bidder's documents have been prepared and sent to the four companies bidding on the project: Bechtel, Fluor Daniel, United Engineers-UHDE and Ebasco-Foster Wheeler. The contract will be awarded in the first quarter 1993. Construction Management bidding documents are being prepared now, with contract award expected by mid 1993.

Dave Cowdrick also emphasized the value John McDaniel from EPRI and Bernard Schleper from UHDE have provided in the design review of existing processes related to our project design. They also have specific experience with syngas coolers, operations and maintenance, and the Cool Water project.
Greg Nelson, Environmental, Tampa Electric discussed the environmental issues and processes. Major items discussed were related to water discharge, demineralized wastes offsite, transmission lines, sufficiency issues and the state permitting schedule. Greg further discussed air emission permitting, the Land Use & Zoning Process, and the Conceptual Reclamation Plan. Greg Nelson emphasized the criticality of meshing the EIS preparation by DOE with TEC's SCA effort.

Jack Doolittle, Environmental Consulting & Technology Inc. gave an environmental status update: Tampa Electric submitted the Conceptual Reclamation Plan Application to the Florida Department of Natural Resources (FDNR) on October 13, 1992. Comments on our SCA application were received from FDNR in late November 1992.

The Land Use Hearing was held on October 29, 1992, in Polk County. No comments or issues were raised at the hearing. The recommended order stated that the project is consistent with and in compliance with, existing land use plans and zoning ordinances and was filed November 12, 1992.

TEC provided to DOE 10 copies of responses to additional information requests from U.S. Department Of Energy (DOE) on the Volume of Environmental Information (EIV). TEC also provided comments on the transcript from DOE's scoping meeting.

John Duff, Project Manager, Tampa Electric showed the site location details and an overview of the site power block, cooling pond and transmission areas. John also discussed the wetlands area, soil borings at the site, wild life corridor, clay settling pond and the earthwork/revegetation package.

Bill Preston, Texaco, gave an overview of the gasification process (block flow diagram), syngas cooler configuration (1 gasifier, 1 radiant heat exchanger, 2 convection coolers and 2 gas/gas exchangers) and the expected system performance at various temperatures. Air emissions related to cold and hot gas cleanup were also discussed. It was noted that Texaco expects to issue their preliminary engineering package on December 7, 1992.

Tampa Electric has finalized the license agreements with TPA, Inc. TPA is a subcontractor to Texaco for preliminary engineering for the sulfur recovery unit and tail gas treatment unit (parts of Cold Gas Clean Up). It was necessary for Tampa Electric to have these agreements to use TPA's specific technology.

Rick Heiman, Texaco, discussed the Industrial Waste Water design philosophy. The design would segregate contaminated streams and combine each type of contaminated stream with other streams containing similar contaminants. The process would further treat each combined stream for only its contaminant and route the combined effluents of each system into an equalization basin and filter before sending the streams to the cooling reservoir.
Paul Wallace, Texaco, discussed the optimization study results along with their cost savings and Heat Rate improvement. The following optimization studies were presented: ASU Compressor Drives, Syngas Cooler Configuration, Clean Gas Heater, Gasifier Train Size, Condensate Heating, Low Temperature Gas Cooling, Acid Gas Removal, Process Water Treating and Hot Gas Clean Up - Tail Gas Treating.

Charlie Cook, GEESI, discussed the hot gas clean up system operation using zinc titanate as the sorbent. The sizing of the absorber tank and regenerator with associated fuel gas piping was discussed. The next testing at Schenectady, N.Y. is scheduled for the last part of 1992. Issues to be resolved are: sorbent life, cost, and removal performance, NH₃, particulate and trace elements.

Carl VanTine, General Electric, discussed the Combustion Turbine component installation, controls, accessories, and exhaust stack installation.

Terry Lynch, General Electric, discussed the combustion turbine rating with an 18 stage, axial flow compressor and a 3 stage turbine, with 2300°F firing temperature. Expected shipment is April, 1994. General Electric has gained field experience and continues to make design improvements to the 7F Combustion Turbine. The Steam Turbine is a Reheat Design/down exhaust with 26" last stage buckets with shipment due March 1995. Three HRSG supplier proposals in final evaluation stage are from domestic companies with shipment scheduled for March 1995.

Initial testing on Low BTU coal gas was completed with no surprises down to 110 BTU/SCF. The testing program will go into the first part of 1993 with Tampa Electric involved in testing.

Upcoming events:

- Award Architect/Engineer Contract
- Bid Construction Manager Services
- Purchase major equipment - SGC, Key Vessels, ASU
- Texaco change over from Preliminary Engineer to Licensor Reviewer

Upcoming Issues:

- Shipment of SGC to site:
  - route/cost
- Oxygen Plant - owner/lease arrangement
- Sale of CO₂
- GEESI HGCU specifications
- MOU
Upcoming Technical Milestones

GEESI Cycle & Design
A/E start
CM bid
Resolve SCA Sufficiency Issues
EIS Implementation Plan
Detailed SGC Design
ASU Design
Follow Industry Progress:
    Shell, Destec, Europe, China
Testing Program

Attachments: Slides & View Graphs
<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
<th>Organizer</th>
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<tbody>
<tr>
<td>Introduction</td>
<td>1:00 p.m. - 1:15 p.m.</td>
<td>DOE/TEC</td>
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<tr>
<td>Project Overview</td>
<td>1:15 p.m. - 2:00 p.m.</td>
<td>TEC</td>
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<td>General</td>
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<td>Overall Engineering Status</td>
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<td>Major Contracts</td>
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<td>Project Description</td>
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<td>Project Team</td>
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<td>Current Status</td>
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<td>Upcoming Events &amp; Issues</td>
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<tr>
<td>Technical Presentation</td>
<td>2:00 p.m. - 3:30 p.m.</td>
<td>TEC</td>
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<td>Site</td>
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<td>Technology Description</td>
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<td>Upcoming Milestones</td>
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<td>Closing Remarks &amp; Questions</td>
<td>3:30 p.m. - 3:45 p.m.</td>
<td>DOE/TEC</td>
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<td>DOE BUDGET PERIOD 1</td>
<td>DOE BUDGET PERIOD 2</td>
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REVISED OCTOBER 1992
## Cycle Optimization Summary

<table>
<thead>
<tr>
<th>Study</th>
<th>Result</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Air Separation Unit</td>
<td>Electric drives selected over steam drives.</td>
<td>$7M Savings*</td>
</tr>
<tr>
<td>2. High Temperature Gas Cooling</td>
<td>Raw gas clean gas exchanger selected over high pressure economizer configuration.</td>
<td>$9.7M Savings, 91 Btu/Kwh Improvement, 5.6 MW Loss</td>
</tr>
<tr>
<td>3. Clean Fuel Gas Heating</td>
<td>Currently being updated.</td>
<td>-----</td>
</tr>
<tr>
<td>4. Gasification Train Number</td>
<td>Ongoing - Syngas cooler vendor to be selected soon and configuration finalized.</td>
<td>-----</td>
</tr>
<tr>
<td>5. Steam Turbine Condensate Heating</td>
<td>Cooling water selected to cool black water flash drum vapor instead of steam turbine condensate.</td>
<td>$400K Savings</td>
</tr>
<tr>
<td>6. Low Temperature Gas Cooling</td>
<td>Three stages of cooling selected over two stages.</td>
<td>$500K Cost, 37 Btu/Kwh Improvement, 1.1 MW Increase</td>
</tr>
<tr>
<td>7. Acid Gas Removal</td>
<td>A chemical solvent was selected over a physical solvent.</td>
<td>$6.5M Savings*, 100+ Btu/Kwh Improvement*, .5 MW Increase*</td>
</tr>
<tr>
<td>8. Effluent Water Treating</td>
<td>Vapor recompression evaporation selected over double effect evaporation.</td>
<td>$1.0M Cost, 46 Btu/Kwh Improvement, 1.4 MW Increase</td>
</tr>
<tr>
<td>9. Hot Gas Cleanup Offgas Routing</td>
<td>Selection was made to convert the hot gas cleanup stream to sulfuric acid.</td>
<td>$7.0M Savings, 51 Btu/Kwh Improvement, .12 MW Increase</td>
</tr>
</tbody>
</table>

*Base case selected. Figure presented represents additional cost associated with option evaluated but not selected.

**Totals:**
- Total Capital Impact = $15.6M Savings
- Heat Rate Impact = 225 Btu/Kwh Improvement
- Capacity Impact = 2.98 MW Lower
COST SUMMARY

TOTAL POLK IGCC PROJECT FORECAST THRU 9/92 25,278.0
TOTAL POLK IGCC PROJECT ACTUALS THRU 9/92 8,970.6
VARIANCE-----> (16,307.4)

POLK DOE ENVELOPE FORECAST THRU 9/92 11,615.0
POLK DOE ENVELOPE ACTUALS THRU 9/92 3,035.8
VARIANCE-----> (8,579.2)

MAJOR CONTRACTS ORIGINALLY ANTICIPATED DURING 3RD QUARTER

<table>
<thead>
<tr>
<th>CONTRACT</th>
<th>DATE</th>
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<tr>
<td>TEXACO GASIFICATION LICENSE</td>
<td>10–21–92</td>
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<tr>
<td>GE ENGINEERED EQUIPMENT PACKAGE</td>
<td>11–06–92</td>
</tr>
<tr>
<td>GEESI HOT GAS CLEANUP ENGINEERING</td>
<td>DEC 1992</td>
</tr>
<tr>
<td>AIR SEPARATION UNIT</td>
<td>EARLY 1993</td>
</tr>
<tr>
<td>KEY GASIFICATION VESSELS</td>
<td>EARLY 1993</td>
</tr>
</tbody>
</table>

TOTAL COMMITMENT -----> 166,850

REVISED OCTOBER 1992
## TAMPA ELECTRIC COMPANY
### POLK POWER STATION
#### 1992 4TH QUARTER REVIEW

**DOE BUDGET PERIOD 1**

|                      | JUL-SEP | OCT-DEC | JAN-MAR | APR-JUN | JUL-SEP | OCT-DEC | JAN-MAR | APR-JUN | JUL-SEP | OCT-DEC | JAN-MAR | APR-JUN | OCT-DEC | JAN-MAR | APR-JUN | JUL-SEP | OCT-DEC | JAN-MAR | APR-JUN | OCT-DEC |
|----------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| COMPLETE PRELIMINARY ENGINEERING (DEC 92) | XX     | XX     |        |         | XX     | XX     |         |         | XX     | XX     |         |         |         |         |         |         |         |         |         |         |         |
| DETAILED ENGINEERING & CM (JAN93 - JUL98) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| STATE PERMITTING PROCESS (ONGOING - OCT93) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| FEDERAL PERMITTING PROCESS (ONGOING - DEC93) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| BID & AWARD SITEMARK PACKAGE (SEP93 - DEC93) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| BID & AWARD CT PACKAGE (SEP93 - DEC93) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| START CONSTRUCTION, SITE DEVELOPMENT & REVETMENT (JAN94 - MAR94) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| CT FOUNDATIONS (MAY94 - JUL94) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| DELIVERY & ERECTION OF CT & ACCESSORY EQUIPMENT (JUN94 - APR95) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| STARTUP/CHECKOUT OF CT (MAY95 - JUL95) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| BID & AWARD BALANCE OF IGCC ERECTION PACKAGE (MAY94 - JUL94) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| COMPLETE BALANCE OF IGCC FOUNDATIONS (AUG94 - DEC94) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| COMPLETE BALANCE OF IGCC DELIVERY & ERECTION (JAN95 - APR96) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| STARTUP/CHECKOUT OF IGCC FACILITIES (MAY96 - JUL96) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |

**DOE BUDGET PERIOD 2**

|                      | JUL-SEP | OCT-DEC | JAN-MAR | APR-JUN | JUL-SEP | OCT-DEC | JAN-MAR | APR-JUN | JUL-SEP | OCT-DEC | JAN-MAR | APR-JUN | OCT-DEC | JAN-MAR | APR-JUN | JUL-SEP | OCT-DEC | JAN-MAR | APR-JUN | OCT-DEC |
|----------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| COMPLETE PRELIMINARY ENGINEERING (DEC 92) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| DETAILED ENGINEERING & CM (JAN93 - JUL98) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| STATE PERMITTING PROCESS (ONGOING - OCT93) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| FEDERAL PERMITTING PROCESS (ONGOING - DEC93) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| BID & AWARD SITEMARK PACKAGE (SEP93 - DEC93) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| BID & AWARD CT PACKAGE (SEP93 - DEC93) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| START CONSTRUCTION, SITE DEVELOPMENT & REVETMENT (JAN94 - MAR94) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| CT FOUNDATIONS (MAY94 - JUL94) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| DELIVERY & ERECTION OF CT & ACCESSORY EQUIPMENT (JUN94 - APR95) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| STARTUP/CHECKOUT OF CT (MAY95 - JUL95) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| BID & AWARD BALANCE OF IGCC ERECTION PACKAGE (MAY94 - JUL94) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| COMPLETE BALANCE OF IGCC FOUNDATIONS (AUG94 - DEC94) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| COMPLETE BALANCE OF IGCC DELIVERY & ERECTION (JAN95 - APR96) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |
| STARTUP/CHECKOUT OF IGCC FACILITIES (MAY96 - JUL96) | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     | XX     |

**CCCCCCCCC** - DENOTES CRITICAL PATH ACTIVITIES

REVISED OCTOBER 1992
## POLK POWER STATION
### UNIT 1 COST SUMMARY
#### PHASES I & II ONLY

$ \times 1,000$

### TOTAL PROJECT CAPITAL SUMMARY

<table>
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<td>HOT GAS CLEANUP</td>
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<td>POWER BLOCK</td>
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<td>SITE DEVELOPMENT</td>
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<td>388</td>
<td>26,156</td>
<td>7,806</td>
<td>1,762</td>
<td>36,202</td>
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<td>PLNT MONITORING &amp; COMMUN</td>
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<td>LAND PURCHASE</td>
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<td>PREVIOUS COSTS (THRU 6/92)</td>
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<td>TOTAL PROJECT</td>
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<td>31,694</td>
<td>515,069</td>
<td>201,258</td>
<td>313,811</td>
<td>100,629</td>
<td>414,440</td>
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<td>DOE REIMBURSEMENT</td>
<td>(6,896)</td>
<td>(6,872)</td>
<td>(53,327)</td>
<td>(25,887)</td>
<td>(7,647)</td>
<td>(100,629)</td>
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<td>236,921</td>
<td>80,343</td>
<td>24,047</td>
<td>414,440</td>
<td>201,258</td>
<td>313,811</td>
<td>100,629</td>
<td>414,440</td>
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</tbody>
</table>

Includes all budget period 1 & 2 capital costs.
System Performance

Expected Output

- Gas Turbine Production 190MW
- Steam Turbine Production 130MW
- Internal Power Consumption 60MW
- Net Output 260MW

Expected Heat Rate

- About 8,500 BTU/NetKWH

Expected Efficiency

- Greater than 40%
## MAXIMUM EMISSIONS FROM THE IGCC UNIT’S CT
(all values lb/hr)

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Post - Demonstration*</th>
<th>Demonstration†</th>
<th>No. 2 Fuel Oil</th>
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<tr>
<td>Particulate Matter**</td>
<td>72</td>
<td>72</td>
<td>27</td>
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<tr>
<td>SO$_2$</td>
<td>518</td>
<td>518</td>
<td>92</td>
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<tr>
<td>NO$_x$</td>
<td>223</td>
<td>664</td>
<td>311</td>
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<tr>
<td>CO</td>
<td>98</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td>VOCs</td>
<td>3</td>
<td>3</td>
<td>32</td>
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</table>

* Maximum emission after the 2-year demonstration period, based on emissions achievable with CGCU. Utilization of HGCU to be based on ability to achieve maximum post-demonstration emission rates.

† Maximum emissions during the 2-year demonstration period, based on up to 50% utilization of HGCC. Maximum post-demonstration emissions rates to be achieved thereafter.

** Includes H$_2$SO$_4$ mist

Source: GE, 1992  
Texaco, 1992  
ECT, 1992
## POLK POWER STATION
### BY-PRODUCTS

<table>
<thead>
<tr>
<th>By-Product</th>
<th>Tons/Yr.</th>
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<td>Sulfur</td>
<td>32,850</td>
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<tr>
<td>Sulfuric Acid</td>
<td>45,000</td>
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<tr>
<td>Slag</td>
<td>98,550</td>
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### DOCUMENT STATUS

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<td>77</td>
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<td><strong>PROCESS FLOW DIAGRAMS</strong></td>
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<td>REISSUED FOR APPROVAL</td>
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<td></td>
<td>54</td>
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<td><strong>PIPING AND INSTRUMENT DIAGRAMS</strong></td>
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<td>REISSUED FOR APPROVAL</td>
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<td><strong>OTHER DRAWINGS</strong></td>
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<td>3</td>
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<tr>
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</table>
DETAIL ENGINEERING CONTRACT STATUS

- SELECTION OF BIDDERS IS COMPLETE
  THERE WILL BE FOUR BIDDERS

- BID DOCUMENTS ARE NEAR COMPLETION AND BIDS WILL BE SENT OUT THIS MONTH

- SELECTION OF AN ENGINEER WILL BE MADE DURING FIRST QUARTER, 1993
CONSTRUCTION STATUS

- SELECTION OF BIDDERS FOR CONSTRUCTION MANAGEMENT IS COMPLETE. THERE WILL BE FIVE BIDDERS

- BID DOCUMENTS FOR CONSTRUCTION MANAGEMENT ARE BEING PREPARED NOW

- SELECTION OF A CONSTRUCTION MANAGER WILL BE MADE DURING FIRST HALF, 1993

- A CONSTRUCTION PLAN WILL BE PREPARED WITH THE CONSTRUCTION MANAGER REFLECTING MULTIPLE CONTRACTORS FOR THE WORK
TAMPA ELECTRIC IGCC RESOURCES

- BERNARD SCHLEPER - UHDE
  - SAR, RUHRCHEMIE EXPERIENCE
  - SYN GAS COOLERS
  - PROCESS DESIGN
  - OPERATING AND MAINTENANCE EXPERIENCE

- JOHN MCDANIEL - EPRI
  - COOLWATER EXPERIENCE
  - COOLWATER VIDEO ARCHIVES
  - COOLWATER TEST AND OPERATING DATA
  - ACCESS TO EPRI'S OTHER TECHNICAL EXPERTISE
DESIGN DEVELOPMENTS

- Making sulfuric acid from HGCU off gas instead of sulfur

- One radiant syn gas cooler with two outlets

- Two convective syn gas coolers
  - One exhausts to a raw syn gas/nitrogen heat exchanger
  - The other exhausts to a raw syn gas/cold syn gas heat exchanger or to the HGCU system

- Syn gas temperature to the CT has been increased from 520°F to 650°F, lowering steam turbine output but improving overall efficiency
FIGURE 3.1.1-1.
GENERALIZED FLOW DIAGRAM OF IGCC SYSTEMS AND PROCESS

UPCOMING EVENTS'

- A/E Award
- Construction Management Bid
- Major Equipment Purchases
- Change in Texaco Role
BUILDING KEY

1. GASIFICATION & GAS COOLING
2. ACID GAS REMOVAL
3. OXYGEN PLANT & RY & TAIL GAS TREATING
4. SULFUR RECL. & RY & TAIL GAS TREATING
5. HOT GAS CLEANUP
6. MAKE UP WATER TREATING
7. CONTROL AND GENERAL SERVICES BUILDING
8. COAL GRINDING
9. CONSTRUCTION POWER FACILITIES
10. ADMINISTRATION BUILDING & VISITORS CENTER
11. INDUSTRIAL WASTE TREATMENT FACILITY & HOLDING BASIN
12. SANITARY WASTE TREATMENT
13. 48 V BATTERY, PBX & RUT
14. CONSTRUCTIONWAREHOUSE
15. MAINTENANCE SHOP
16. CONSTRUCTION LAYDOWN & TEMPORARY CONSTRUCTION PERSONNEL PARKING
17. MOBILE EQUIPMENT MAINTENANCE SHOP
18. OFF-GAS TREATMENT
19. IGCC WASTEWATER TREATMENT

SCALE: 1" = 1250' (FEET)
4 1250'
0 (METERS)
0 1250'
0 500

FIGURE 3.2.0-2
POWER BLOCK AND DIRECTLY ASSOCIATED FACILITIES ARRANGEMENT

SOURCES: UEC 1992: ECT 1992

3.2.0-5
### Tampa Electric

#### Expected Performance

**Pittsburgh 8 Coal**

<table>
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<th>Category</th>
<th>Ambient (°F)</th>
<th>Feed</th>
<th>Fuel Gas</th>
<th>Power</th>
<th>Efficiency</th>
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<td>59</td>
<td>90</td>
<td>654</td>
<td>640</td>
<td>8543</td>
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<td><strong>Feed</strong></td>
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<td>Fuel Gas Consump - LHV (MMBTU/h)</td>
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<tr>
<td>Fuel Gas LHV (BTU/SCF)</td>
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<td><strong>Power</strong></td>
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<td>ST Power (MW)</td>
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<td><strong>Efficiency</strong></td>
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<td>HHV Net Heat Rate (BTU/kwh)</td>
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Tampa Electric
Air Emissions

Emissions (lb/MMBTU HHV Coal)

SO2
NOx
CO
Part

CGCU
CGCU/HGCU
Tampa Electric
Trace Element Air Emissions

Emissions (10^-6 lb/MMBTU HHV Coal)

- Mercury
- Arsenic
- Cadmium
Tampa Electric
Syngas Cooler Configuration

Nitrogen to CT

Raw Syngas to LTGC

Nitrogen from ASU

Clean Gas to CT

Clean Syngas from LTGC

400 psig Steam

Steam

Nitrogen

Convection Cooler

Rad Cooler

Gasifier

HP Steam

HP Steam to HGCU

Clean Gas Htr

Scrubber
Tampa Electric
Low Temperature Gas Cooling Configuration

Syngas From Scrubbers

Clean Gas Preheater

Steam Turbine Condensate Heater

Trim Cooler

AGR

Acid Gas to Claus

Clean Gas to Clean Gas Heater
# Tampa Electric Optimization Study Results

<table>
<thead>
<tr>
<th>Optimization Study</th>
<th>Cost Savings ($/kw)</th>
<th>Heat Rate Improvement (BTU/kw-h)</th>
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<tbody>
<tr>
<td>1) ASU Compressor Drives</td>
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<td>2) Syngas Cooler Configuration</td>
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<td>3) Clean Gas Heater</td>
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<td>4) Gasifier Train Size</td>
<td>—— under study ——</td>
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<td>5) Condensate Heating</td>
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<td>6) Low Temperature Gas Cooling</td>
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<td>7) Acid Gas Removal</td>
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<td>8) Process Water Treating</td>
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<tr>
<td>9) HGCU - Tail Gas Treating</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>42</strong></td>
<td><strong>225</strong></td>
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</table>
Tampa Electric
Air Separation Unit Optimization
(Study 1)

Optimum ASU

- electric compressor drives

- high pressure cold box (50 psig)

- all nitrogen routed to combustion turbine

- compressor heats nitrogen (limited intercooling)

- supplies soot blowing nitrogen

- supplies low pressure oxygen to Claus
Tampa Electric
Syngas Cooling Optimization
(Study 2)

Optimum Cooling System

- dual fire tube convection coolers
- separate nitrogen and fuel gas heaters
- raw gas/clean gas exchanger recovers low level heat
- high chrome metallurgy is cost effective
Tampa Electric
Fuel Gas Heating Optimization
(Study 3 and 6)

Optimum Heating System

- higher fuel gas temperature reduces overall plant cost
- higher fuel gas temperature increases efficiency
- raw gas/clean gas exchanger provides highest temperature
- scrubbed syngas/clean gas exchanger provides cost effective heating
Optimum Treating

- primary separation by vapor recompression
- secondary separation by LP steam evaporation
- brine cake production by drum dryer
- steam turbine condensate heating in WWT is not cost effective
Tampa Electric
Sulfur Removal Optimization
(Study 7 and 9)

Optimum Removal

- amine based AGR provides low cost and good efficiency for CGCU
- HGCU tail gas treating in dedicated acid plant
- LP oxygen used to concentrate combusted sulfur streams
INDUSTRIAL WASTE TREATMENT
DESIGN PHILOSOPHY

- SEGREGATE CONTAMINATED STREAMS.

- COMBINE EACH TYPE OF CONTAMINATED STREAM WITH STREAMS CONTAINING SIMILAR CONTAMINANTS.

- TREAT EACH COMBINED STREAM FOR ONLY ITS CONTAMINANT.

- COMBINE EFFLUENTS OF EACH SYSTEM INTO EQUALIZATION BASIN AND FILTER BEFORE SENDING TO COOLING RESERVOIR.
ENGINEERING

- Higher Fuel Temperature And Lower Fuel Pressure At Delivery Point – Improved Cycle Efficiency

- Control Valves For High Temperature Syngas Tested At CR&D; Valve Selection Has Been Made

- Product Engineering And Design Now Fully Released
LOW BTU COAL GAS COMBUSTION TESTING

- DOE/EPRI/GE Cooperative Agreement Screening Program
  - Determine effects of moisture, nitrogen and carbon dioxide as diluents
  - Determine emissions characteristics (NOx, CO, etc.)
  - Operate on two syngas compositions – air blown and integrated oxygen blown to confirm combustion characteristics are in line with predictions

- Initial Tests Complete – No Surprises – Able to Maintain Stable Combustion Down To 110 BTU/SCF With Predicted Emission Levels

- Plans (With Proposed Modifications)
  
  **Remainder of 1992:**
  - All 1/2 flow tests
  - DOE generic air blown gas
  - NH3 to NOx conversion

  **First Half of 1993:**
  - Head end N2 injection
  - Head end N2 injection

  **TECO Production Development Testing**
  - Baseline CGCU
  - HGCU
  - NH3 to NOx conversion
  - Final design mods
**HRSG**

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**Exchange With Gasifier**

- Steam and water from the combined cycle plant to the fuel plant:
  - Steam flow of 26,600 lb/hr at 78.1 psia, 312.4°F
  - Steam flow of 18,500 lb/hr at 84.0 psia, 654.6°F
  - Steam flow of 14,300 lb/hr at 394.1 psia, 443.2°F
  - Water flow of 715,800 lb/hr at 250.0 psia, 108.5°F
  - Water flow of 27,200 lb/hr at 250.0 psia, 315.0°F
  - Water flow of 515,200 lb/hr at 2015 psia, 593.2°F
  - Water flow of 11,200 lb/hr at 415 psia, 418.3°F

- Steam and water from the fuel plant to the combined cycle plant:
  - Steam flow of 515,200 lb/hr at 1650 psia, 609.6°F
  - Water flow of 715,800 lb/hr at 230 psia, 207.2°F
  - Water flow of 87,900 lb/hr at 230 psia, 287.1°F
  - Makeup flow

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**Supplier Proposals (3) In Final Evaluation Stage**

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**Shipment March 1995**
STEAM TURBINE

- Conventional Double Flow Reheat Design; Down Exhaust

- Change From 30” LSB To 26” LSB
  - Significant Cost Reduction
  - Improved Performance At 90°F Ambient
    - 785 KW output increase
    - 13 BTU/KW-HR decrease

- Shipment March 1995
## MS7001F GAS TURBINE

### FIELD EXPERIENCE DESIGN IMPROVEMENTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Plan</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Combustion liner seal loosen; weld quality</td>
<td>Requalify weld process; revise weld design</td>
<td>Implemented</td>
</tr>
<tr>
<td>o Combustor fuel nozzles coke on oil; face cracking</td>
<td>Redesign fuel nozzle tip</td>
<td>Installed on operating units; awaiting results; implemented on new units</td>
</tr>
<tr>
<td>o First stage nozzle localized leading edge oxidation</td>
<td>Improved cooling configuration</td>
<td>Underway</td>
</tr>
<tr>
<td>o First stage bucket cooling blockage – casting process</td>
<td>100% air flow check at GE and vendor</td>
<td>New units and retro-fit</td>
</tr>
<tr>
<td>o First Stage bucket coating quality; inadvertent coating removal during post coat cleaning</td>
<td>Improved process/inspection</td>
<td>Test at GE implemented</td>
</tr>
<tr>
<td>o First stage bucket tip oxidation – trailing edge</td>
<td>Provide trailing edge cooling – redesign exit channel</td>
<td>Vendor to start tests</td>
</tr>
<tr>
<td>o Second stage air ejector comes loose</td>
<td>Fix in short term</td>
<td>Eliminated cleaning</td>
</tr>
<tr>
<td>o Second stage nozzle creep found</td>
<td>Permanent redesign</td>
<td>Studying coating sensitivity</td>
</tr>
<tr>
<td></td>
<td>Replace FSX–414 material with GTD–222</td>
<td>Design concept validated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New tooling in place</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Short term set screw stacking in place</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Redesign underway</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Implemented</td>
</tr>
</tbody>
</table>
MS7001F GAS TURBINE

PRODUCT ELEMENTS

- 18 Stage Axial Flow Compressor
- 3 Stage Turbine
- 2300°F Firing Temperature
- Multi-Nozzle Standard Combustor
- Packaged Accessory Modules
- Shipment April 1994
GE ENGINEERED EQUIPMENT PACKAGE DESCRIPTION

- **MS7001F Gas Turbine** 192 MW Nom. (Gross)
  - Packaged Design
  - H₂ Cooled Generator
  - Nitrogen Diluent on Syngas
  - Water Injection on Distillate

- **Double Flow Reheat Steam Turbine** 124 MW Nom. (Gross)
  - 1450 psig/1000°F/1000°F
  - H₂ Cooled Generator
  - 26 Inch LSB

- **Heat Recovery Steam Generator (HRSG)**
  - 3 Pressure Level
  - Integral Deaerator
  - Reheater

- **Power Plant Engineering**
  - Define Power Island Auxiliary Equipment
  - Define Power Island Controls For Integration Into IGCC Plant Controls

Nov. 1992
UPCOMING MILESTONES

- GEESI Contract
- A/E Start Work
- Environmental Sufficiency
- EIS Implementation Plan
- Detailed Syngas Cooler Design
- Detailed ASU Design
- Industry Progress
  - Shell
  - Destec
  - Europe
  - China
- Testing Program
MAJOR ISSUES TO RESOLVE

- 1 vs 2 Gasifiers
- Shipment of Syngas Coolers
- "Over The Fence" Oxygen Supply
- Sale of CO₂
- Potential Methanol - Cool Water Arrangement
- Hot Gas Clean-Up Detailed Design
- MOU
- Truck Coal
January 5, 1993

Nelson F. Rekos, Jr.
U.S. Department of Energy
Morgantown, WV 26507-0880
P.O. Box 880

RE: Quarterly Report - October - December 1992
Tampa Electric Company - IGCC Project

Dear Nelson:

On November 12, 1992 Tampa Electric Company, TECO Power Services, General Electric, General Electric Environmental Services and Texaco met in Morgantown with the U.S. Department of Energy (DOE) Morgantown Energy Technology Center (METC) project staff. An additional attendee included Tampa Electric's environmental consultant, Environmental Consulting & Technology.

This meeting was the quarterly review meeting for the subject project, for the fourth quarter of 1992, and was intended to provide an overview of the current status of the Tampa Electric IGCC Project. This document and its attachments will also serve as the participant’s report for the 4th quarter.

During this meeting project team members from DOE, Tampa Electric, TECO Power Services, General Electric, General Electric Environmental Services, Texaco and Environmental Consulting & Technology introduced their assignees to the project.

The major topics addressed and discussed at the meeting were:

1) Overview of the project progress.
2) Project description: MW, Heat Rate, Emissions, by products and cycle optimization studies.
3) Construction approach to the project.
4) Project Team arrangement.
5) Project cost and schedule.
6) Current status of the project as it relates to Tampa Electric Company.
7) Regulatory update.
8) Tampa Electric Company’s engineering involvement related to preliminary engineering and preparing A/E scope of work.
9) Environmental update.
10) Gasification process overview.
11) License agreement update.
12) Industrial Waste Water design philosophy.
13) Optimization study results.
14) Hot Gas Clean Up system update.
15) Combustion Turbine component installation, rating and testing.
16) Upcoming events.
17) Upcoming Issues.
18) Upcoming Technical Milestones

Attached to this Quarterly Project Report are the minutes and handouts form the Quarterly Review Meeting for you information. Should you require additional information or clarification regarding the fourth quarter 1992 review, please advise.

Cc: Mr. G.F. Anderson
    L.L. Lefler
    J.A. Newcomb
    D.E. Pless
    R.N. Howell
    J.T. Duff
    File M11.8
    File R2.1.2

C. R. Black
Project Director
END

4/30/194

DATE

Filmed