GL00811

Attachment 1

# SUMMARY TECHNICAL EVALUATION REPORT

1. Contractor: Technology International, Inc.

2. SCAP No.: DE-SC07-80ID12139

3. Description: This project is to provide thermal energy for a fuel alcohol plant in Vale, Oregon.

4. Summary of Review:

   A. Environmental

An environmental report is currently being prepared in conjunction with the PRDA study underway at the site. The scope of this report is not discussed nor is any detail provided to indicate how this report would be updated or expanded for the UCCDP. Statements such as "no wildlife exists in the Rhineland Buttes" implies that the proposer is unfamiliar with environmental issues. An environmental budget of $2,800 with 40 hours allotted to a consultant may represent too low of an effort to generate an acceptable report. This would be dependent upon the quality and amount of work that has been done for the PRDA report.

The quality of the geothermal water has not been determined since the reservoir has not yet been tested. The proposer plans to use the 1,500 ft exploration hole for injection if surface discharge is not acceptable. The proposer should be aware that just because they have a 1,500 ft well does not automatically make it suitable for injection.

The statement is made that a 195,000 gal reserve pit will be used to hold drilling fluids and cuttings and hydrothermal fluids while testing. The construction and design of the pit is not described, although it is stated that some repair will be done to assure that no loss of fluids will occur. Greater detail, such as if the pit is lined and, if so, with what, should be provided.

The proposer should be aware that the environmental report prepared for DOE does not need to address the proposed ethanol plant, nor does DOE approval of the UCCDP environmental report imply government environmental approval of the plant.

The question of fluid disposal is just barely addressed. The proposer must prove to DOE's satisfaction that a 1500' well will be adequate for injection of spent geothermal fluids and that he has the appropriate permits for fluid injection at that site.

B. <u>Resource and Exploration</u>

In that the geological exploration of the area is to be completed by PRDA work, and that no exploration is planned under this proposal, it is recommended that the UCCDP contract be signed with the stipulation that all PRDA exploratory obligations will have been met before proceeding on UCCDP work.

There must be some time and money allowed for exploration in the event the PRDA findings are not sufficient for locating a production well drill site.

A detailed geologic mapping program of the area should be obtained.

It is recommended that at least 5 thermal gradient holes be drilled.

A conductive gradient is unlikely to be present all the way to the reservoir due to convection in a vertically permeable zone, in which case the referenced 150-200°C/km geothermal gradient should not be expected in the Technology International lease area. A lower gradient is probably present.

C. <u>Drilling</u>

The 30" conductor pipe could be eliminated.

The 20" could be set with either the rig or a "conductor setting rig" to 80' to 100'.

Since the 9-5/8" casing will be set from surface to 4000', the 13-3/8" casing may be set for a shallower depth. This would depend on a number of parameters not explicitly detailed in the proposal.

Since cementing of the 13-3/8" is considered a potential problem, "inner string cementing method" is recommended. The "inner standard method" for cementing large casing which is set to shallow depths where a competent cement job is required. This is the case here. The 13-3/8" casing is over designed and 9-5/8" production casing under designed.

The wellhead pressure rating is considerably over designed for the anticipated conditions.

The proposed drilling fluid program should be justified. Low lime mud does have a good medium temperature stability for drilling. However, it can be easily contaminated by $CO_2$. This is highly likely in a low-to-medium temperature liquid-dominated reservoir.

Drilling and completion techniques are for the most part technically sound overall, and sufficient detail has been provided to indicate that the prospective contractor possesses the necessary knowledge to successfully drill the proposed 6,500-ft. production well.

Geothermal Exploration Consulting Corporation (GEC) is identified to provide drilling engineering services, but it is not clear if it is intended that GEC will provide drill site supervision services.

The testing procedures are based upon a nonartesian flow while the completion procedures anticipate artesian flow in that the 9-5/8 inch casing is being run to the surface. Maybe the 9-5/8 inch casing should be installed as a liner with the top at some reasonable depth to provide for running a larger diameter pump that would be possible inside the 9-5/8 inch casing.

It is not clear how a foaming agent will be used with water drilling. Generally foaming agents are used while air drilling and some formation waters are being produced.

The technique of dumping sand down the annulus, to fill what space was not filled by cement, must be completely disallowed. In a high temperature resource such as this one is, serious problems would very likely occur in the future when shallow, cooler water in the sand was made to boil as its temperature was raised by passage of produced hot geothermal fluids from depth. That water expanding to steam, accompanied by an increase in pressure, would very likely collapse the casing, necessitating expensive remedial casing work. That portion of the 7" production liner which is above the producing zone should be cemented in place, also. Failure to successfully complete any cementing job must be followed by the running of a cement bond log and remedial cement squeezes.

Unless the surface formations are extremely incompetent, the need for two conductor casings is questionable. In fact, the 18" pipe already in place at the proposed location may be sufficient for the job. The casing program should be reviewed with the intent of using smaller pipe. Centralizers should be used more often than every 120', or not at all. Every other joint is the recommended minimum.

There appears to be an error in Vol. 1, Fig. 21, p. 94 since the expansion spool should be below the master valve, not above it, as shown, to allow the 9-5/8 inch casing to extend into and seal inside the expansion spool.

A full complement of BOPE is recommended on the 9-5/8" assembly. The Hydril alone, as shown in Figure 20, is insufficient. The underbalanced drilling condition described on Page 96 - drilling with no returns - should be regarded as extremely hazardous considering the anticipated 340°F resource.

There is no detailed discussion on completion or testing of the exploration well that is being drilled under the existing PRDA. This is important if the well is to be used for injection.

Chip sampling intervals are not specified; chips should be collected every ten feet.

The thermal gradient holes drilled in the PRDA should be geophysically logged, to record a combination gamma ray-SP-dual induction log.

Logging of the production hole should include a neutron density/ gamma ray log, and should include the addition of a NCL to the GR-FRC run.

The Cement Bond Log should be eliminated unless obvious problems are encountered. An acoustic porosity device should be run in its place.

D. Testing

The testing program is not sufficiently detailed and the costs seem rather low. This is especially true since there is indication for a need for pumping the well. Pumping will probably be required to achieve the desired rate of 700 GPM. The cost for the pump and the pump installation should be included. Also, the proposed wireline method of monitoring bottom hole pressures with a pump in the well in 9-5/8" casing is not common practice. Probably wellhead pressure temperature and flow rates with a "bubble tube" in the well is safer for the well, more reliable and much cheaper. In other words there should be more consideration given to the testing program for this particular type of well. With the little known geology and hydrology of the area, more conservative cost and technical procedure approaches should be taken.

E. End Use

The process energy requirement is quoted as 40.1E6 BTUH on Page 30, which translates to 70576 BTU/GAL ETOH. This figure is somewhat higher than the 60,000 BTU/GAL anticipated, but it is reasonable and perhaps exhibits warranted conservatism. However, if the 9.7E6 BTUH for "Flashing and Process Losses" are added, the requirement becomes 87,648 BTU/GAL ETOH. The requirement was also deduced based on mass flow rates downstream of the flash separator as given in Figure 13, Page 36. For discharge of the hot geothermal water at 195°F after process use, the energy requirement was 75,477 BTU/GAL ETOH. As much useful energy is lost by reinjecting at this temperature, the process should be further investigated to use the 195°F water. (The block diagram on Page 36 also shows 208,000 PPH going to disposal at 210°F with no attempt at heat recovery).

The geothermal source wellhead requirement is stated on Page 40 as 320,000 PPH of 331°F water, deduced in the calculations to be at saturation conditions. The available energy is thus 170,000 BTU/GAL ETOH. To allow for transmission losses enroute to the plant, the mass flow rates and temperatures downstream of the flash separator were next examined. It was also assumed that the hot geothermal water could be cascaded further and discharged at 140°F. This resulted in an available ethanol production energy of 103,300 BTU/GAL. Thus, the conditions for complete success used in developing the cost share plot are optimistic and in favor of the proposer.

The by-product drying energy was examined. The evaporation requirement of 40E6 BTUH listed on Page 29 is misleading. According to the P&ID, a large portion of the 40,000 PPH of water will be removed by centrifuge. Therefore, the demand is too high and indeed conflicts with the 20E6 BTUH figure given on Page 30. More information will be required to check the details of this latter drying number, which translates to 35,200 BTU/GAL ETOH, definitely high.

The distillation energy requirement was checked, and the steam flow rate of 6708 PPH shown on Page 36 was found to be in error. The required flow to meet the 7.4E6 BTUH distillation demand is 7745 PPH of 235°F saturated steam. Note that this flow can then be cascaded through the mash preheater, thus satisfying the hydrothermal water energy demand of 1.1E6 BTUH shown on Page 30. The mash can be preheated through a temperature rise of about 21°F with the still bottoms. The larger flow rate given above should provide for more efficient column operation because the mash is not subcooled significantly. If this procedure is followed, the 20,420 PPH hot water requirement shown on page 36 can be eliminated in favor of steam.

More information will be required to check details of the azeotropic distillation energy requirement. Figure 12 of the P&ID should provide for drawing liquid from the top decanter layer for re-injection into the dehydrator column.

The block diagram presented on Page 36 is confusing in terms of the P&ID. It is recommended that revised P&ID's be solicited, with complete mass and energy balances documented on these drawings.

The proposer is unclear as to whether steam will be used, in spite of their claim of plans to use a proven process; this must be determined ahead of time as it influences the cost share plan. If steam is to be used, we question their claim of losing 100°F during flash separation. Engineering input is needed on this matter. The proposer should be made to reconsider his process flow to recycle and save some of the heat. A reject water temperature of 195°F is highly undesirable. Fluids of that temperature would constitute a substantial resource almost anywhere else. Appropriate incentives should be established to encourage the proposer to cascade the spent ethanol plant fluid through other uses.

Process energy requirements are inaccurately shown by Figure 14 (page 39-vol. I). Not all processes, P1 through P5, require fluids in the 240°F-340°F range. This figure would be most deceiving in arriving at a fair (to DOE) cost share. The reader need only refer to a discussion of the individual processes (pp 25-28) to see that Figure 14 is clearly wrong.

The 340°F temperature sought is excessive! It is stated that (pg 152) water at 235°F would supply 100% of the project's energy needs.

The proposer may have trouble getting the necessary quantities of cold process water from domestic shallow wells in this area.

F. Cost

There appears to be a cost extension error for the drilling contractor on page 6 of the business proposals. Also, the cost estimate for the drilling fluids seems rather low since the potential for lost circulation problems is rather high.

The proposer's financing needs to be demonstrated to DOE's satisfaction through appropriate bank documents.

DOE auditors should ascertain that there are no funds requested in this proposal, which were covered by the PRDA funding, to avoid double paying for any work item.

The 45-day period identified for drilling is appropriate and realistic but disagrees with the 30 days used for the cost estimate. A 30-day flow test period is identified yet the cost estimate includes a 90-day long-term test. The inconsistencies should be discussed in negotiations.

Drilling Contractor - $216,000 - The cost assumes a 30-day rig operation, including mob./demob. of $25,000. Rig hourly rate costs are, therefore, ($216,000-$25,000) ÷ 30 ÷ 24 = $265.00/hr* which are reasonable for the type of equipment required to drill and complete the production well. 40 days of rig operations is a more realistic requirement for the 6,500-ft. production well and $50,000 a reasonable minimum of rig mob./demob. More probable drilling contractor costs are, therefore, $265.00 x 24 x 40 = $254,400 + $50,000.00 or $304,000.00. Note discrepancy with $170.00/hr. stated on Vol. II, p. 6.

Prepare New Site - $150,000 - Unless the new site is extremely unusual, this item may be overstated by about $75,000 to $100,000. Since the prospective contractor's lease encompasses a known 1 square mile area, perhaps he could provide a detailed estimate based upon the least favorable site conditions in the lease boundaries.

Drill Bits - $42,238 - Overall quantities of bits are reasonable, but cost may be understated if more than one of the seven 8-3/4 inch bits are insert types. For example, change the last four mill tooth bits to insert type (see Vol. II, p. 14) and incremental cost increase would be ($3,600 - $980) x 4 = $10,480.

Contingency - $204,376 - A 25% cost overrun on an exploratory - geothermal hole is not unrealistic, but it is excessive as an allowable cost in the basic contract. Perhaps 10 to 15% is reasonable and should be allowed.

Well Testing - $66,260 (Vol. II, p. 18) - The total amount for both short and long-term testing is reasonable. However, there is no cost for downhole pump rental.

Injection Well and Piping System - $200,000 - Since there are no details of well or piping system construction given, a definitive evaluation is not possible. An injection well in the 1,500 - 2,000 ft. depth range could reasonably cost from $90,000 to $120,000 and the $135,000 estimate is considered at most 10 to 25% overstated. The $65,000 for the injection piping seems high, but a description of the system is required for a reasonableness of cost determination.

G. Cost Share

The cost share plan is poorly presented in its dependence on enthalpy to define the degree of success. Enthalpy is itself dependent on many variables (TDS, dissolved gasses, and pressure effects) rendering it a poor gauge of success. The cost share plan needs to be reworked for many reasons. Besides the enthalpy problem, the proposed cost share plan does not reflect the step-function nature of the temperature and flow requirements of the process; a reasonable flow at 90°F should be the lowest step.

H. General

There appears to be an inconsistency in the proposers address.

The resumes for both the drilling engineer and testing consultants do not indicate adequate training or experience in their respective project positions.

The technical review reveals that they apparently have a competent consulting group to manage their drilling operations.

I. Recommendations

1. The environmental report being done through the existing PRDA, should be made available to DOE.

2. The 1,500 ft test well may not be adequate for injection. A contingency plan should be developed. Permits and proof that the 1,500 ft level is suitable for injection should be submitted.

3. The design of the fluid reserve pit should be submitted with greater detail.

4. All data and interpretations acquired through the existing PRDA should be provided to DOE. There is a strong feeling that the TI lease holds may not contain an optimum site for drilling a deep geothermal well, in which case DOE may not want the obligation. It is felt that a contract should not be negotiated until all data is evaluated.

5. The PRDA contract should be reviewed to see if there is any overlap of work with the UCCDP proposal.

6. Revised P&ID's should be submitted to DOE with complete mass and energy balances documented.

7. What provision does DOE have if the 1,500 ft gradient hole will provide sufficient flow and temperature for the ethanol plant?

8. There are inconsistencies between the times allotted for drilling and testing and the cost estimates. Cost inconsistencies exist between Technical and Business volumes.

9. The proposers financing should be documented.

10. The site preparation of $150,000 is high.

11. The cost share should be negotiated to define the success at the stated minimum temperature of 235°F.