Client

Gas Development Project A

PROJECT No. _____
FILE No. _____

CONSTRUCTABILITY STUDY – FACILITIES

	Reviewed and Approved	Date
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	CONTRACTORS Doc. No.	
	CLIENT Doc. No.	

Revision	Description	Date
A	Issued for review and comments	1 Dec-04
B	Incorporated comments	2 Dec 04
C	Incorporated comments	7 Dec 04
D	Issued for Client comments	7 Dec 04
0	Issued – incorporated Client comments	15 Dec 04

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1.0 INTRODUCTION

1.1 Purpose

To stay competitive in today's energy market, there is a need to be able to produce new resources efficiently. With the proper implementation of a constructability plan, independent organizations such as Construction Industry Institute (CII) claim reductions of approximately 4% of total project cost and 7.5% schedule reductions are not uncommon. In addition intangible benefits including enhanced maintainability, reliability, operability, and safety are often seen.

CII defines constructability as "the optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve overall project objectives."

This constructability study outlines the construction requirements that are essential to the success of the construction and installation of the field facilities portion of the Project Gas Development Project.

1.2 Objectives

The focus of the Constructability Study is on obtaining upgrades during the early phases of the project. The objectives of this Constructability Study is to work within a structured process for incorporating CLIENT, co-venturer, and construction knowledge to identify upgrades early in the life of the project which will enhance project safety, quality, cost, schedule and risk management objectives.

Additionally, it is intended to foster continuous inter-group communication and cross training as well as providing a structured mechanism to incorporate Constructability Lessons Learned from previous projects into design of current projects.

Early constructability involvement will provide maximum benefit to the project in the form of cost reductions, schedule improvement, and enhancements to quality, safety, regulatory, and environmental.

1.3 Abbreviations / Acronyms

DBM	Design Basis Memorandum
GIS	Global Information System
PDM	Project Development Memorandum
PDS	Project Design Specifications

1.4 Method

In order to provide a structured process for incorporating construction knowledge in the early phases of the project that will enhance project safety, quality, schedule, cost, and risk management objectives, it has been decided to utilize a checklist approach.

In that approach, a comprehensive checklist was developed based on eight key areas of the project execution, which are:

1. Schedule
2. Design (broken into three sub-parts – simplicity, standardization, and facilitation of construction)

3. Layouts and Arrangements
4. Modularization
5. Environmental and Regulatory
6. Specifications
7. Plans and Logistics
8. Construction Execution Issues

The checklist was then used in a series of meetings or interviews with key discipline leads, as well as CLIENT personnel. As stated previously, this approach helps to foster continual inter-group and inter-function communication.

Additionally, this approach provides a structured mechanism to incorporate constructability lessons learned from the previous projects.

The impacts of each issue have been rated as High, Medium, and Low and are described as such:

- High - More than USD $10MM and/or 2 month or more schedule impact
- Medium - Between USD $1MM – $10MM and/or 1-2 month schedule impact
- Low - Less than USD $1MM and/or less than a 1 month schedule impact

At this stage of the project development, the quantification of impacts is somewhat subjective and previous experience has been used in order to place each issue into an impact category.

While only the High and Medium items were included in the body of the Study, it is strongly encouraged to utilize Appendix 1 as a go-by for follow up and incorporation of the constructability findings into the detail design phase. While singularly, these items are in the low impact range, in aggregate, they represent a significant savings to the project in the form of cost and schedule.

The Constructability Study for the Field Facilities has identified four action item(s) for Category High issues and thirty-three action item(s) for Category Medium issues.

It is recommended to conduct at a minimum two future comprehensive Constructability Reviews when detail design is approximately 25% and 75% complete respectively. These reviews should be conducted in a workshop-type manner with the following disciplines being represented - engineers, construction, safety, quality, operations, environmental, and regulatory personnel as a minimum.

1.5 Scope of Work

The focus of the Project Gas Field Development Project Constructability Review is to obtain upgrades and verification during early phases of the project through the involvement of experienced CLIENT, CONTRACTOR, and consultant construction personnel.

The review covers all applicable project phases (preliminary engineering, detailed design, procurement, and construction) except start up; and to all project components including the fabrication and installation of the gas plant. This is accomplished by:

- Reviewing key elements of Engineering (Design) plans and deliverables
- Identifying potential enhancements to design and planning which improve overall quality, safety, costs, and schedule
- Identifying significant construction execution challenges
- Verifying contracting strategy/plans for construction/installation in light of execution challenges and execution strategy

See Table 1 for an overview of optimum constructability input timing during the key stages of the Project.

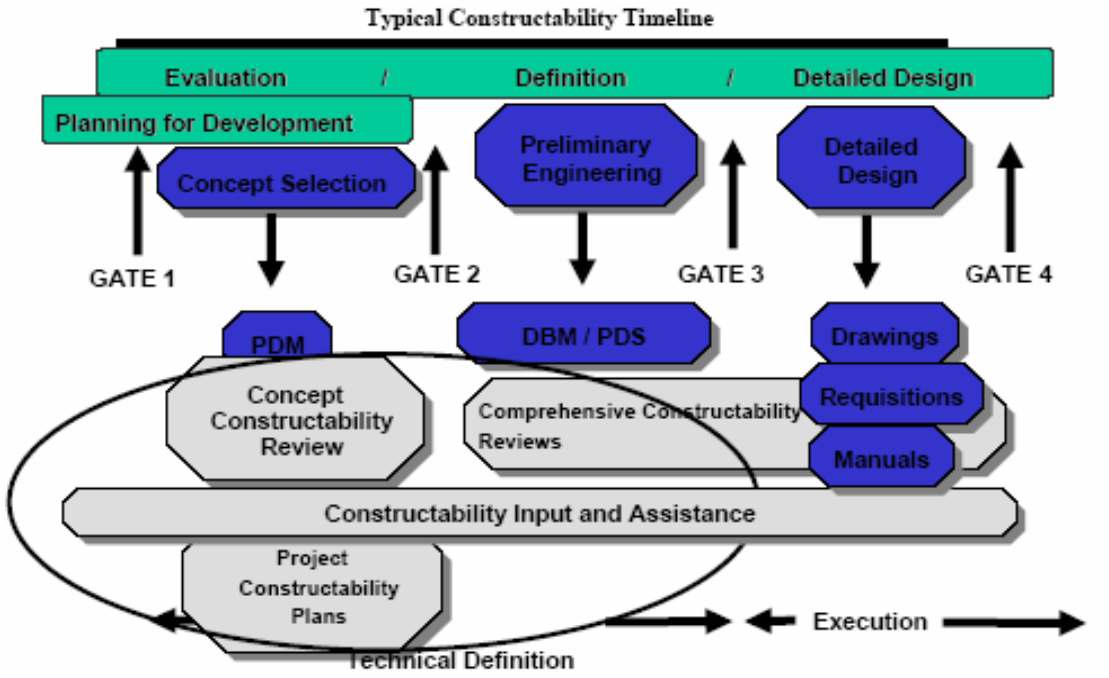

Table 1

At this early stage of the Project, there are a variety of unknowns regarding labor, equipment, and subcontractor availability in-country, as well as materials that are available in the quantity and quality that is required to support the Project execution.

Remote sites, such as Project, have unique challenges in the context of safety, security, accommodations, language barriers, telecommunications, medical support, catering, industrial hygiene, waste management, etc. As such, a number of assumptions have been made from a construction standpoint and should be clarified. The key assumptions made are:

- Many common systems/support services/standards will be available to be used by the Contractor (i.e. aviation services, medical services and evacuation, permitting, and land allocation services, etc.). Some services may be paid for by the Contractor on an “as-used” basis, such as evacuation.

- Pad construction will be completed as per the schedule to allow full access to the process area.
- The required temporary accommodations and storage yards will be made available in proximity (within 20 kms) to the work Site. This will include all required permits and building approvals.
- Security for all other sites (port, any interim storage yards, and the pad site) will be provided with secured perimeters, to include a security fence and 24-hour guards at a minimum.
- Local support services are available, such as water well drilling, civil subcontractors (for temporary facilities construction support), clerical support, drivers, translators, etc.
- Import procedures will be well defined for the Contractor with regards to temporary import of materials and equipment, as well as importation of materials for fabrication of the permanent facility. The performance and associated cost of this activity is the Contractor's responsibility, it will be helpful for the Contractor to have the In-Country import/export requirements during the tender phase.
- There will be minimal delays in customs clearance provided Contractor follows all existing laws and agreements and is in compliance with CLIENT guidelines.
- Current projected deliveries for procured materials and equipment will hold firm.
- Aggregate is available in adequate quantities and quality for concrete mixing.
- Quality diesel fuel in bulk is available in-country for construction needs.
- Supplies of gases (oxygen, acetylene, nitrogen, argon, etc.) are available in-country for construction needs.
- There are no import restricted materials that would be utilized for construction activities and if so, the materials would be available in-country at a reasonable cost.
- Employment standards (Fair employment standards, payment of overtime, child labour, etc.) are not onerous;
- Registration of businesses (to perform work in In-Country) and the registration of motor vehicles is relatively straightforward. This will allow any anomalies in the In-Country registration system to be planned for and included in the Contractor's execution planning and scheduling;
- There are no limitations or restrictions on the importation and/or use radiation sources
- Licensing of transport drivers, trucks, etc, licensing of equipment other than light motor vehicles are readily accomplished;
- Port permits will be provided by CLIENT;
- There are no restrictions on the use of expatriate or third-country national skilled labor.

Should the CLIENT Business Unit advise that any of these assumptions are invalid, the impacts will need to be looked at on a case by case basis and the effect quantified in terms of cost and/or schedule impact.

1.6 Project Description

The Project is the development of the Project Gas (and Condensate) Field located in northeast In-Country, in Block __. The field is about ___ kilometers wide and __ kilometers long, and is located 150 kilometers northeast of _____, 50 kilometers miles southwest of the gas producing _____ Plant, and 50 kilometers northwest of the _____ future Gas Plant.

The Project Field will be developed in 2 phases corresponding to a 2-pad (drilling program) development with the possibility of a third pad north of the _____ river if extended reach wells from the existing pad cannot be technically or economically justified during detailed engineering.

The field facilities to be installed as part of the Project Gas Development Project will be developed in two phases, and include the following:

- Two well pads, _____ Site and _____ Site (with the possibility of adding a third depending on the viability of extended reach drilling activities)
- Four production trains rated at ___-MMSCFD each for a total throughput of ___-MMSCFD
- Gas gathering pipeline (__" x __ km) connecting the _____ pad to the _____ pad where the gas plant will be located
- Gas plant, consisting of: loading & transfer pumps; flare, power generation; fire and gas system; SCADA; inlet separation, gas dehydration and gas metering; condensate stabilization through staged depressurization, storage, condensate, pipeline pumps, and metering; produced water, degassing, storage and disposal; associated utilities, including flare and blow down system, power generation and distribution, fuel gas, diesel fuel, instrument air, utility air, fire water utility, water systems, open/closed process drain systems.
- Gas plant, including drilling/production area, process area, flare area, and permanent accommodations area, to be built on a work pad of approximately 12' of thickness made up of dredged, hauled and compacted material.

1.7 Construction Plan

According to the latest revised Project schedule issued at the time of this report, the site grade work on the _____ Pad will commence _____. The construction activities will continue through the dry season when the majority of work will be accomplished. Commissioning of the facility is scheduled for _____ which will require some completion works to be done during the rainy season.

The detail design and procurement sequencing and methodology must incorporate the need for accomplishing some of these works during the rainy season or to accelerate certain activities to complete prior to the rainy season. This will include designs that allow for sequencing of deliverables to facilitate early installations during the site work phase, minimizing on-site sandblasting/painting, developing contingencies for late arrivals of equipment, issuance of all foundation drawings to allow simultaneous installations, etc.

Installation of the North Pad buildings and equipment will commence shortly after contractor mobilization and will continue throughout the dry season, culminating in early _____.

It is strongly recommended to procure a minimum of 50% of the common bulk materials early in the design and procurement process; this will include cable trays, cable, tubing, underground pipe, etc. and have that material on-site no later than _____ in order for the contractor to begin fabrication, coating, and installing the early and underground facilities as soon as possible upon mobilization.

The early and underground facilities will include: open and closed process drain system, water sewer system, fire water ring main system, electrical/instrumentation required in pipe rack and sleeper areas, foundations, and sleepers/pipe racks.

2.0 SCHEDULE

The project schedule was looked at to determine if the schedule is feasible given construction windows (weather and/or specialty equipment available, including work space).

As part of the schedule review process, a couple of key scheduling issues were investigated: 1) to determine of the sequence or procurement deliverables is derived from construction logic, and; 2) to determine of the sequence of contracting deliverables is derived from construction logic.

And finally, the sequence of design deliverables was examined to determine if the planned scheduling was derived from procurement and construction logic.

The overall finding is that the facilities field construction portion of the schedule needs some additional work in order to develop sound construction logic and sequencing to form a basis for the design deliverables and procurement efforts.

Only those issues that have been determined to have a “High” or “Medium” impact have been shown below. Additionally, those issues that were looked at and where there was a solution in place or are not applicable have been captured in the working checklist, but are not listed here.

For a complete listing of all the issues and findings, see Appendix 1.

The checklist questions and the subsequent findings, actions, impacts, and notes are as follows:

1. **Is proposed project schedule feasible from a construction standpoint? (e.g. are weather and equipment availability windows taken into account or for tie ins allowable shutdown timing is reflected in schedule)?**

   Findings:
   It will be very difficult for a contractor to be awarded a contract, organize, mobilize, and only have part of one dry season in which to work.

   Current schedule shows contract award and contractor mobilization to consume three months of dry season.

   Actions:
   Develop mitigations and work arounds to assure Project success. Possible mitigations include:

   A. Accelerate the contract tender & award phase in order to allow the construction contractor to plan & start mobilization earlier in the schedule.
   B. Modify the schedule in order to allow for the award of the construction contract so that the construction contractor can mobilize and do some preliminary site work, including setting up of camps, equipment yards, laydown areas, etc. and to perform some early site civil works, including underground piping in the 1st dry season.
   C. Look at completing in two dry seasons with a demobilization and remobilization between the two dry seasons
   D. Assure the designs enable early enclosure or allow fabrication in enclosures.

   Actions Assigned To:

TBD

Potential Impact:
High

Notes:
It is considered to be risky and potentially costly to attempt to complete this project in a single rainy season.

The pad construction is on the critical path and is the key to completing construction of the facility within the prescribed time frame.

Progress on pad construction should be monitored, tracked and projected at a minimum on a weekly basis, including review of quality reports.

2. **What is the planned sequence of drawing production? Does this sequence compare with the fabrication sequence? Is the sequence of engineering, procurement, and contracting deliverables derived from construction logic?)?**

Findings:
It is too early to determine. These issues and details will be addressed during detail design.

Actions:
A. Assure the packaging of designer work (division of scope of work) is directed by construction logic.
B. Assure timing of design sequencing is determined by construction logic.

Actions Assigned To:
TBD

Potential Impact:
Medium

3. **Will schedule permit sufficient design completion prior to start of fabrication of engineered equipment? What is agreed % of design completion?**

Findings:
Fabrication of engineered equipment will be the responsibility of the vendor and hence he will be responsible for making the decision of when to initiate fabrication. Procurement activities do not support the construction schedule.

Actions:
A. Look at accelerating procurement of early activities (foundations, piles, underground piping, water wells, etc.)

Actions Assigned To:
TBD

Potential Impact:

Medium

4. **Does schedule account for recruitment and training for local work force?**

   Findings:
   For CLIENT personnel, i.e. IT, security, medical , the schedule does allow for recruitment and training. For facilities contractor's labor force development, the schedule does not currently consider the impact.

   Actions:
   Develop realistic estimates on amount of time to recruit and train locals and incorporate into the IPS.

   Actions Assigned To:
   TBD

   Potential Impact:
   Medium

5. **Have long-lead-time activities that involve both construction and startup been identified in the schedule (e.g.):**
   - **Water supply/disposal for hydro-testing and flushing of piping)**
   - **Purchased power**
   - **Equipment**

   Findings:
   For construction - yes, these have been identified in CLIENTs supplied tender documents and they are: glycol system, generator sets, fire water pumps, instrument air skid, MCC bldg, and inlet separators. CONTRACTOR is currently developing specifications.

   Start up has not been addressed specifically

   Actions:
   Refine the long lead items list; identify any potential equipment not included that should be a long lead item.

   Expedite the specifications development / approval cycles.

   Look at Start Up requirements and incorporate into the Integrated Project Schedule.

   Actions Assigned To:
   TBD

   Potential Impact:
   Medium

6. **Does the overlap between commissioning and startup allow for the minimization of hot-work? (e.g. does the schedule identify and minimize time period when construction must**

work in an area with live lines, or commissioned hydrocarbon lines, or hot electrical lines)?

Findings:
Should be developed by the Business Unit during detail design and coordinated by the Contractor after tender award.

Actions:
Make standardized skeletal sequence networks available to engineering, procurement, construction, and start-up personnel for review and markup.

Actions Assigned To:
TBD

Potential Impact:
Medium

7. **Does sequence of design deliverables (e.g. piping, grounding grid, duct banks) allow installation to occur early during site work phase?**

Findings:
It is too early to determine. These issues and details will be addressed during detail design.

Actions:
A. Assure that schedule effectiveness is considered as a performance criterion for vendor selection.
B. For large purchase orders and multiple deliveries, the specific sequence of material delivery and delivery dates should be specified in the purchase order.

Actions Assigned To:
TBD

Potential Impact:
Medium

8. **Has a critical path analysis been done on the schedule? What are the critical activities? What is planned to manage them?**

Findings:
Yes, the ROW survey, engineering, PL procurement, and pad construction have been identified as the critical items.

Actions:
A system is needed to manage the tasks under the SOW, including contingencies and work around plans in order to effectively plan and assure scheduled tasks are being met on or ahead of schedule.

The system will include the monitoring of pad construction schedule, including forecasts of resources used and identify potential gaps, accelerate where possible, taking particular care with the quality of the pad construction.

Actions Assigned To:
TBD

Potential Impact:
High

3.0 Design

The design sequencing was looked at to determine if the sequencing supports the construction plan, if the design is as simple as possible, and if the advantages of repetition can be realized through the design process.

For clarity, the design review was broken into three sub-parts:

3.1 Design – Overall
3.2 Design Elements – Standardization
3.3 Design to Facilitate Construction

All of the design components were reviewed in order to determine if they were construction driven, does the design allow for parallel construction, and has it been sequenced from a construction and/or commissioning standpoint.

Only those issues that have been determined to have a “High” or “Medium” impact have been shown below. Additionally, those issues that were looked at and where there was a solution in place or are not applicable have been captured in the working checklist, but are not listed here.

For a complete listing of all the issues and findings, see Appendix 1.

The checklist questions and the subsequent findings, actions, impacts, and notes are as follows:

3.1 Design – Overall

1. **Is there a Global Information System (GIS) requirement? If so, how will it be integrated into the design?**

   Findings:
   Yes, GIS is planned to be utilized. ArchInfo is currently in use.

   Actions:
   Develop a comprehensive plan for integrating design data and information into the selected GIS system, including procurement, construction, and as-built data.

   Actions Assigned To:
   TBD

   Potential Impact:
   Medium

3.2 Design Elements - Standardization

1. **Have applicable Lessons Learned from previous projects been applied? Which applicable lessons were not applied and why? Which have been applied?**

   Findings:

Yes, but no details as far as particulars.

Actions:
Develop a formal Lessons Learned workshop early in the detail design to incorporate previous experience into the design effort.

Actions Assigned To:
TBD

Potential Impact:
Medium

3.3 Design to Facilitate Construction

1. **Do available transportation options place limitations on how and where fabrication should occur?**

   Findings:
   Yes. The river has limited availability, air is not an option, ground transportation is the constant viable means of transporting and this has issues as far as limitations of infrastructure. Rail is not an alternative.

   Actions:
   Look at upgrading bridge(s) to increase size and Contractor limitations.

   Actions Assigned To:
   TBD

   Potential Impact:
   Medium

2. **Would design of this component be affected by a particular fabrication yard? (e.g. limits diameter, length, draft, etc.)?**

   Findings:
   Potentially yes, it will be looked at in detail design.

   Actions:
   Assure task is performed.

   Actions Assigned To:
   TBD

   Potential Impact:
   Medium

3. **Does each isometric contain a bill of materials?**

Findings:
Has not been considered yet.

Actions:
Field fabrication will be minimized, recommend for the field fabrication that will be done, developing spool sheets that have BOM's.

Actions Assigned To:
TBD

Potential Impact:
Medium

4. **Has the design considered utilizing as much or the permanent utilities (water, electricity, air) for temporary construction needs)?**

Findings:
With the exception of providing communication services to the Contractor, other permanent utilities will not be provided to the contractor on site.

Actions:
Look at possibility of accelerating early work to provide some utilities to contractor at the site. This will allow contractor to mobilize and come up to speed much faster and prevent him from having to provide double all utilities (at the temporary camp location and for construction at the facilities site).

Actions Assigned To:
TBD

Potential Impact:
Medium

4.0 Layouts and Arrangements

The layouts and arrangements of the facilities were looked at to determine if the equipment arrangements within the plot plan were optimized to allow for ease of installation and hook ups and assure the physical arrangements and dimensions promote efficient construction practices.

The layouts were looked at to see if they were driven by construction/installation logic.

Only those issues that have been determined to have a “High” or “Medium” impact have been shown below. Additionally, those issues that were looked at and where there was a solution in place or are not applicable have been captured in the working checklist, but are not listed here.

For a complete listing of all the issues and findings, see Appendix 1.

The checklist questions and the subsequent findings, actions, impacts, and notes are as follows:

1. **Does the General arrangement of facilities reflect construction needs:**
   - **Size and location of laydown areas**
   - **Contractor facilities, including accommodations**
   - **Site access for workforce**
   - **Workforce parking**
   - **Warehouse and material storage facilities**
   - **Traffic flow (both pedestrian and vehicular)**
   - **Accessibility for materials and equipment, especially large vessels, modules or preassemblies**
   - **Accessibility for people**
   - **Security considerations**

   Findings:
   No plan is envisioned for temp facilities on the pad with the exception of communications. CLIENT is attempting to locate sufficient land in proximity to the site to provide for the temporary construction needs.

   It will have a large impact on the contractors’ execution planning if sufficient space is not allotted to him.

   Actions:
   A. Source the land, acquire necessary permits to lock in the land for the contractor’s use, based on CONTRACTOR’s recommendations as to site area land requirements and locations needed.

   Actions Assigned To:
   TBD

   Potential Impact:
   High

2. **How many interfaces are required as the facilities are currently laid out? Can this number be reduced?**

Findings:
Seven interfaces have been identified: 1-pad construction, 2-pad road construction (internal roads on the pad), 3-in-field road construction, 4-drilling, 5-pipeline, 6-security and, 7-operations.

Actions:
The number of interfaces can be reduced by placing internal pad road construction into the Construction contractor's SOW and having CLIENT provide security for the Facilities site(s).

An Interface Management Plan should be developed to provide a road map for overall coordination.

A dedicated Interface Coordinator should be assigned. The Coordinator should have the responsibility to identify, define, and manage technical, execution, and organizational interfaces with CLIENT, CONTRACTOR, and any other outside contractor through a structured process as defined by the IMP.

Actions Assigned To:
TBD

Potential Impact:
Medium - High

5.0 Modularization

Overview

The concept of optimizing modularization of the facilities was looked at to determine if the equipment and facilities lend themselves to a high degree of modularization and what, if any restrictions will impact modularization.

General Analysis of Modularization Drivers

Modularization is considered for projects with unusual project conditions. The standard modularization drivers are listed below with remarks related to the envisioned Project Field Facilities work.

Restricted by severe weather patterns – In-Country does have severe monsoon seasons and a low unit cost for labor. This is considered a factor in consideration of modularization for this project.

Remote locations - The Project facility location is relatively remote and also is considered to be a factor in justifying modularization, however, the limitations on infrastructure are considered to be detrimental to any significant modularization.

Restrictions on manpower - The prediction regarding the availability of manpower resources in year 2005 may have some bearing; however, this in itself would not appear to justify modularization.

Limited space or laydown areas - Plot space is limited and is a consideration for modularization.

Safety or shutdown concerns - Safety or shutdown execution is not a modularization consideration for the Project field facilities.

Permit limitations - Current schedules allow sufficient time to obtain environmental and other related permits without impacting the start of construction.

Commercial impact for time to market - Time to market is a consideration in the overall execution plan and schedule.

In looking at the Project design, execution basis, and standard modularization drivers, it is clear that the logistical envelopes that the Project must work within are the ultimate drivers behind size and types of skid packages. As many of the Project parameters as contrasted above indicate, modularization provides optimal benefits to the Project. Modularization has been maximized to the extent possible, however, the logistical restrictions place a limit and impact on the amount of modularization that can be accomplished.

In addition to the equipment skids, it is envisioned to modularize the MCC building. This will present no logistical or constructability issues.

6.0 Environmental and Regulatory

The issues concerning environmental and regulatory and how they may impact construction was looked at and determined if the design allows for maximizing shop fabrication and minimizes field installations. These include regulations as well as 3rd party impacts.

Only those issues that have been determined to have a "High" or "Medium" impact have been shown below. Additionally, those issues that were looked at and where there was a solution in place or are not applicable have been captured in the working checklist, but are not listed here.

For a complete listing of all the issues and findings, see Appendix 1.

The checklist questions and the subsequent findings, actions, impacts, and notes are as follows:

1. **Does design take into account seasonal or weather considerations, which will be present during construction? (e.g. does design of underground facilities take into account water table and other soil conditions)?**

   Findings:
   Yes, i.e. electrical & instrumentation wiring, cables, and boxes are in sealed, moisture resistant enclosures, shelters, etc.

   There is a "site evaluation" document, _____, Site Conditions and Climate, that is environmental in nature and has been developed and is being developed by CONTRACTOR with input from CLIENT. CONTRACTOR is currently planning to reference the document in all vendor package specifications.

   Actions:
   Assure task is performed.

   Actions Assigned To:
   TBD

   Potential Impact:
   Low - Medium

2. **Does design properly account for geotechnical data?**

   Findings:
   No geotechnical data has been received to date. Soil borings to begin in December.

   Actions:
   Need to receive pad construction data, including compaction tests and geotechnical data from site survey as soon as possible.

   Actions Assigned To:
   TBD

   Potential Impact:

Medium

3. **What environmental restrictions are placed on installation? Can they be minimized by design?**

Findings:
Zero pollutant discharge on water discharges and air emissions at a minimum for both the temporary and permanent construction and operations sites.

Rain/Monsoon season will have a major impact on the Project

Actions:
A. Develop definitive criteria for air and water emissions and include in Tender. Additionally, waste handling and disposal requirements will need to be included in the Tender packages.
B. Contract and tender process to allow for maximum amount of "dry" season work.

Actions Assigned To:
TBD

Potential Impact:
Medium

4. **What is the plan for disposal of construction and start up wastes? Are any considered hazardous?**

Findings:
For camp wastes such as food, an incinerator will be used, construction solids to be packaged and sold if applicable, otherwise incinerated. Hazardous material handling requirements is unknown as is the in-country definitions of what constitute hazardous material.

Actions:
A. Develop plan for dealing with and disposal of hazardous materials.
B. Develop a Waste Management Plan outline to include in Tender package, request contractor to provide Plan with tender submittal.
C. Source and provide a listing of Waste categories from the In-Country government

Actions Assigned To:
TBD

Potential Impact:
Medium – High

5. **Have all socio- economic considerations which could delay construction been addressed? How?**

Findings:
The issues that could affect construction include: labor, uncooperative land owners, and community relations have been identified.

Actions:

A. CLIENT will take the lead on these issues.

B. Need to develop: Socio-economic Action Plan, which would include a Community Relations Plan, External Affairs Plan, Activists Response Plan, and a Media Plan. These documents need to be made available to the Contractor during the tendering process.

Actions Assigned To:

TBD

Potential Impact:

Medium

7.0 Specifications

The issues regarding the development and issuing of project specifications and how construction input at this stage could result in a more efficient and cost effective system being built have been looked at. Additionally, we need to assure that design and fabrication specifications are consistent.

Only those issues that have been determined to have a “High” or “Medium” impact have been shown below. Additionally, those issues that were looked at and where there was a solution in place or are not applicable have been captured in the working checklist, but are not listed here.

For a complete listing of all the issues and findings, see Appendix 1.

The checklist questions and the subsequent findings, actions, impacts, and notes are as follows:

1. Are material procurement specifications consistent with construction drawings?

Findings:
These will be addressed during detail design.

Actions:
Assure task is performed.

Actions Assigned To:
TBD

Potential Impact:
Medium

8.0 Plans and Logistics

The issues regarding project plans and logistics was looked at, including how specific plan development, as well a logistical workarounds could provide benefits to the project. Additionally, plans need to reflect construction methodologies and strategies.

Only those issues that have been determined to have a “High” or “Medium” impact have been shown below. Additionally, those issues that were looked at and where there was a solution in place or are not applicable have been captured in the working checklist, but are not listed here.

For a complete listing of all the issues and findings, see Appendix 1.

The checklist questions and the subsequent findings, actions, impacts, and notes are as follows:

1. **Do cost and schedule estimates reflect productivity experience?**

   Findings:
   Not yet, data is being developed and incorporated as it is received.

   Actions:
   Continue to gather data and incorporate.

   Actions Assigned To:
   TBD

   Potential Impact:
   High

2. **Will parts of systems be turned over to operations early? (e.g. power generation, sanitary sewers, or offices) Will design take turnover plan into account? For tie ins to existing facilities does design address tie in strategy and operations shutdown philosophy?**

   Findings:
   The plan is to have the contractor develop a Mechanical Acceptance criteria and Mechanical Completion criteria and to develop a comprehensive turn over package including a system by system checklist to be submitted for approval.

   Actions:
   Assure task is performed and the requirement captured in the Tender documents.

   Actions Assigned To:
   TBD

   Potential Impact:
   Medium

3. **Will mechanical completion be phased or sequenced? Does design account for this?**

   Findings:

This will be evaluated during detail design. The contractor will be required to develop a Hook Up and Commissioning (HUC) plan to be submitted for approval.

Actions:
Assure task is performed and incorporated into the Tender documents.

Actions Assigned To:
TBD

Potential Impact:
Medium

4. **Do plans assure equipment adequately protected during shipping and interim storage? How is this checked? By whom?**

Findings:
The plans and specification are currently under development – it is envisioned to have full alignment and seamless execution.

Actions:
A. Assure task is performed and incorporated into the Tender documents using GS-038, Export Packaging.
B. Need alignment on Procurement and Logistics, including a discussion of interfaces, roles & responsibilities, etc.

Actions Assigned To:
TBD

Potential Impact:
Medium

5. **Are customs and tax/duties processes and costs fully understood and have they been taken into consideration on the schedule and cost estimates?**

Findings:
At current it is not fully defined, especially with regards to contractors' temporary import of equipment & material. CLIENT business unit will provide assistance.

Actions:
Investigate local requirements and incorporate information into the tender packages.

Actions Assigned To:
TBD

Potential Impact:
Medium

6. **Is there a plan for QC'ing engineered equipment?**

Findings:
Work will be performed by a 3rd party through CLIENT

Actions:
Assure proper interface between CLIENT, CONTRACTOR, 3rd party, and Contractor

Actions Assigned To:
TBD

Potential Impact:
Medium

7. **Are requirements known for importation of equipment and bulks for in-country fabrication?**

Findings:
The current requirements are not clearly defined. The plan is for the CLIENT Business Unit to develop a list if in-country contacts that can provide details.

Actions:
Investigate as fully as possible and include findings in the tender packages.

Actions Assigned To:
TBD

Potential Impact:
Medium

8. **How will emergency situations, i.e. medical evacuations be handled during construction? During operations? Helipad?**

Findings:
Current plan is to drive to _____ and take a commercial flight from there for medivac situations.

Client is doing an on-going evaluation of the local clinics.

It is planned for the Contractor to be able to utilize the CLIENT medivac system and pay for the service on an as used basis.

Actions:
Tender package needs to contain information on the current medivac plan and need to advise Contractor of the minimum standards that are expected for camp and site locations and request a Medivac Plan as well as an Emergency Evacuation Plan.

Actions Assigned To:
TBD

Potential Impact:
Medium

9. Is there a clear delineation of responsibilities between CLIENT and CONTRACTOR for procurement activities? Are roles & responsibilities defined? Are the systems required (i.e. material management) available and able to be integrated?

Findings:
At this point it is not 100% clear. There is a potential for overlap or gaps in the procurement system, i.e. material management, tracking and expediting responsibilities, reporting, etc.

A meeting is scheduled in _____ to provide clarity.

Actions:
Need to develop a clear procurement SOW with clear demarcations of responsibility, and with a formal process in place to transfer responsibility. Additionally, any systems requirements (i.e. Material Management) need to be defined.

Actions Assigned To:
TBD

Potential Impact:
Medium

9.0 Constructability Issues for Design

The general constructability issues for design concentrate on field level details where some input into the design can provide huge savings, both is terms of cost and schedule.

Only those issues that have been determined to have a “High” or “Medium” impact have been shown below. Additionally, those issues that were looked at and where there was a solution in place or are not applicable have been captured in the working checklist, but are not listed here.

For a complete listing of all the issues and findings, see Appendix 1.

The checklist questions and the subsequent findings, actions, impacts, and notes are as follows:

1. **Is there a strong commitment to be construction driven? Evidence of commitment?**

   Findings:
   At this point, yes. This Constructability Study is evidence.

   Actions:
   Need to assure implementation of Project constructability plan.

   Actions Assigned To:
   TBD

   Potential Impact:
   Medium

2. **Are there any labor relations considerations? Do plans and strategies effectively address these?**

   Findings:
   It is planned to have the Contractor to develop a local labor recruitment and training plan and to incorporate that into the tender submittal.

   Actions:
   Assure requirements are clearly spelled out in the tender packages.

   Actions Assigned To:
   TBD

   Potential Impact:
   Medium

3. **Does the procurement plan consider having vessel final inspections at vendor site performed by whoever will perform the final inspections at site? (Eliminates surprises and last minute problems.)**

   Findings:
   Not in the CONTRACTOR SOW – Client to address.

Actions:
Coordinate 3rd part inspection personnel to possibly allow for this synergy.

Actions Assigned To:
TBD

Potential Impact:
Medium

4. **How will SIMOPS be managed and coordinated?**

Findings:
A SIMOPS Coordination Plan is being written by the CLIENT Business Unit.

Actions:
A. Need to finalize the overall plan for managing SIMOPS and determine who will steward (Specific person within the CLIENT organization).
B. Need to include in the tender package rates to capture downtime due to SIMOPS and include a provisional sum for contract management purposes.

Actions Assigned To:
TBD

Potential Impact:
Medium

5. **Are clients expectations of safety and safety performance well-defined. Is safety a top goal of the project? Evidence?**

Findings:
CONTRACTOR received a Safety standard (_____) from a previous project as go-by. CONTRACTOR is currently developing it as a project-specific safety document.

Actions:
A. Safety needs to be advertised and pushed more, including adding safety as 1st item on each meeting agenda.
B. Clear safety expectations should be developed and issued.
C. Comprehensive safety coordination procedures should be developed and included in the tender package.

Actions Assigned To:
TBD

Potential Impact:
Medium

10.0 ADDITIONAL RECOMMENDATIONS FROM LESSONS LEARNED

Lessons Learned are defined as the process of leveraging past knowledge and experiences, both positive and negative, to future behaviors, whereby the past contributes to the creation a better future. As with all forms of learning, lessons learned are key paths for continuous improvement in project success.

The sources for the following Lessons learned have been a variety of projects world-wide for construction and the associated services (i.e., procurement, logistics, security, safety, etc.). All have become the basis for a tremendous pool of lessons to draw from and that encompass many, if not all of the intricacies and challenges of the _____ Gas Field Development Project. These lessons, which if successfully applied on this project, will certainly open doors for greater successes with fewer struggles.

The following are some of the key Lessons Learned that can be applied:

1 **A highly proactive and structured approach should be followed in the areas of safety, security, and health.**
Mandatory vaccinations should be conducted prior to site mobilization. Defensive driving courses and routine safety inspections should be conducted at site.

Project management team should obtain a firm commitment from EP&C contractors. Because contractors have varying safety cultures, proper attitudes should be obtained through contracting mechanisms such as incentives and procedures.

Full time health extension officers should be assigned at each work location.

Site security should receive a great deal of attention. A detailed security plan, which should address a drug and alcohol policy, is required in order to maintain controls at the work site and minimize theft and work disruptions. Civil war, saboteurs and third party interference should be considered potential problems.

Armed police and guard dogs deter threats, but local security is likely to be ineffective due to conflicts of interest. A Security Risk Assessment should be carried out prior to mobilization to field.

2 **A comprehensive communications plan consisting of public affairs, community affairs, etc. is critical to the success of the project.**
When communicating with the governmental bodies, the number of company representatives should be limited.

It's imperative to develop a formal and detailed response plan for Non-governmental Organizations (NGO's), environmental activists, union organizers, media representatives, etc. and communicate it to the field.

3 **Managing cultural differences among the contractor, government and joint operations will prove to be challenging.**
Project management personnel should attend cultural briefings in order to better manage joint operations and a multi-national staff.

Project director should have an active role in maintaining relations and influence with the government.

Multi-lingual personnel and translators should be employed to minimize the impact of language differences.

4 Integrated team consisting of CLIENT and EPC contractor expedites available resources.

CLIENT and EPC contractor personnel should be co-located.

5 Detailed logistics/construction planning is critical to project success.

Housing and feeding locals at site rather than busing may result in improved productivity and working conditions.

Due to limited water supply consider sourcing water from water trucks, water wells and/or a nearby rivers/water bodies.

6 Construction manpower and mobilization requirements should be carefully planned, especially in the civil and indirect categories.

Constructability/construction issues are greatly impacted by the climate, site conditions and remoteness of the construction sites.

Dual fuel engines may be required because of the unavailability of power and inconsistent supply of diesel.

The final civil design could be completed in the field due to the diverse soil makeup along the pipeline route.

Because of heavy rainfall fixed roof tanks should be used as opposed to floating roof tanks.

7 The procurement procedures/plan should reflect in-country conditions.

Special emphasis should be given regarding the amount of time and effort required to evaluate the capabilities of local suppliers.

The early development of a QA/QC program simplifies QA implementation.

A comprehensive material requisition schedule should be integrated with the engineering schedule.

Equipment should be inspected promptly on arrival in-country.

8 The contracting procedures/plan should reflect in-country conditions and the quality of the work scope.

In general execute reimbursable contracts when definition is lacking and lump sum/unit price when the scope is clearly defined.

Civil contracts should generally be reimbursable while mechanical works and buildings lump sum.

Prohibit marginally qualified contractors from bidding, and reject marginally qualified bids.

9 A Constructability Coordination Procedure should be included into the ITT package for the Contractor to implement upon contract award.

It imperative that the contractor is made aware of the expectations and he is prepared to carry forward with the constructability goals and objectives.

10 Contracting Issues

Be mindful of issuing lump sum contracts too early. Scope of work will be poorly defined and design data incomplete

Early in the FEED process, develop realistic schedule for issuing contracts. Award contracts when there is sufficient information to reduce contractor's contingency and minimize orders and other claims

11 Develop a FEED level design risk assessment

Risk assessments are not HAZOP's, but are a supplement used to form the overall basis for risk management. This will include the appropriate design personnel. Results of the risk assessment should be evaluated by appropriate risk reduction measures

12 Significant differences will exist between accepted local standards, CLIENT Corporate Standards, and In-Country law. There is a need to develop and apply project standards universally to extent possible

The Business Unit should provide site minimum specifications, standards, policies, and requirements for each fabrication/construction site and take appropriate actions to accommodate:

- Safety Policy
- Site Quality Program
- Work Permits (Visas)
- Construction Permitting
- Emergency Response Plan - Site Evacuation
- Accommodations/Living Standards
- Public Affairs Plan - Press/NGO's at Site
- Medical / Medivac (CLIENT vs. Contractor)
- Vehicle / Driving Policy
- Site Access Requirements
- Industrial Hygiene (Training/Orientation/Medical)
- Security
- Site Gear (PPE, Jungle, etc.)
- Waste Mgmt.
- National Hiring Req.'s/Labor Law Considerations
- Catering Standards
- Safety Incentives Program
- Spill Response
- Remote Site Standards Policy (What's acceptable in infrequently visited or remote sites in context of accommodations – e.g. survey locations, vendor sites, non camp/non infrastructure areas)
- Contracting Standards for small Local Contracts (vs. Standard CLIENT/CONTRACTOR Model)

13 Existing in-country support services most likely will be limited in context of large project demands – translators, drivers, vehicles, and miscellaneous procurement, aviation management, etc. Project may need to substantially supplement these resources

APPENDIX 1 - CONSTRUCTABILITY CHECKLIST

The complete constructability checklist used to produce the above study has been included in its entirety. The complete checklist captures all of the constructability issues investigated and encapsulates the findings from all issues including low to high.

It is recommended to utilize the complete constructability checklist as a follow up tool to incorporate all of the actions, including the low Category items into the detail design phase.