Doseo Pipeline Project
Modularization Overview – Advantages/Disadvantages & Drivers

PURPOSE

Modularization will be evaluated herein as a cold eyes look into the potential construction technique to be applied to the Doseo Pipeline Project. This analysis will include a review of the drivers that typically influence a modularization approach along with an appropriate cost analysis of modularization on a major scale if applied to the Doseo Pipeline Project.

A review of the typical schedule drivers and how they apply to the Doseo Pipeline Project is necessary before making a final decision on this mode of execution. To that end, the following overview and background are offered for consideration.

GENERAL ANALYSIS OF MODULARIZATION DRIVERS

Modularization is considered for projects with unusual project conditions. These are listed below are the typical conditions along with remarks related to the envisioned Doseo work.

- Restricted by severe weather patterns – Chad has some severe rainy seasons that are often protracted. This is a positive factor in consideration of modularization for this project.

- Chad has a relatively low unit cost for labor, however, the efficiency of the labor has yet to be determined. Therefore, this may or may not be a factor in consideration of modularization for this project, but chances are it will be.

- Remote locations - The Doseo Pipeline has severe logistical challenges and is expected to be a factor in justifying modularization. However, there may be limited pre-assembly and modularization opportunities for the pump stations that are relatively remotely located. This opportunity for prefabrication should be evaluated during the FEED effort.

- Restrictions on manpower - The prediction regarding the availability of manpower resources in year 2016-2018 may have some bearing but is unknown at this point; however, the current schedule is predicated on an EPC approach in order to ensure least cost. Unless Chad limits the number of visas for Expatriates and TCN's, this in itself would not appear to justify modularization.

- Limited space or laydown areas - Plot space does not appear to be a consideration for the Doseo Pipeline or other facilities.

- Safety or shutdown concerns - Safety or shutdown execution is often a consideration for modularization; however, in the case of the Doseo Pipeline safety or shutdown concerns are not a modularization consideration.

- Permit limitations - Current schedules allow sufficient time to obtain environmental and other related permits without impacting the start of construction, therefore permit limitations would not be a factor in consideration of modularization for Doseo.

- Commercial impact for time to market - Time to market, to date, has not been a significant consideration in the overall execution plan and schedule to date.

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BACKGROUND ISSUES

Various background issues are offered below and include:

- Generally full modularization of a facility is a more expensive mode of execution, but does compress schedule.

- Assuming adequate modular construction can be identified, module fabrication facilities need to be considered and whether the fabrication yards are in Chad or elsewhere.

  If elsewhere, this may have an impact on the local content requirements for Chad. If Chad local content is or becomes an issue, a region needs to be targeted that can provide facilities and qualified contractors with a low labor unit price considering cost of transportation logistics and other factors.

  If in Chad, the likely benefit would be a reduced level of manpower at the job site. Assuming safety and quality remain a constant, this will likely decrease construction costs for temporary foundations and piles, increase costs for structural stiffening, transportation and module setting.

- There are numerous early schedule considerations for modularization. If modularization is utilized, the execution strategy for the EPC Contractor will need to address details within the split of work for engineering and materials management. Plans may promote early procurement of long delivery items being supplied to module fabricators, which may fall to Glencore to issue early PO's.

- At this point in time, without knowing who the EPC Contractor will be, it is assuming the EPC contractor is willing and able to accommodate modular design and material logistics.

- The Doseo pipeline facilities plot plans (at a detail level) has yet to be developed, and a modular execution plan will affect early engineering such as influencing the equipment locations and the resultant layout. In order to commence the study, a plot plan with equipment located needs to be available. In addition, the Doseo pipeline facilities site locations are not fixed and therefore no geo-technical data is currently available.

COST ANALYSIS

A detailed cost analysis will need to be performed. As we are not to that point yet, the discussion below presents a typical analysis overview of the cost factors that are impacted by a major modularization effort. It is normal to assume that 35% of piping could be modularized.

Due to the preliminary status of the Doseo pipeline facilities design, the information contained in this analysis overview is general in nature. No specific costs are available and the cost data shown below consists of principles or general industry percentages. The basis for the data is an accumulation of reasoning, the experience of previous modularization work, and past studies.

General industry opinion is that modularization will increase costs over a stick built project by 5% to 40%, possibly more, where the stick built approach would normally be used. As noted in this

overview however, there are many factors that support a modularization of the pipeline facilities which may drive the concept to cost and schedule effectiveness. The following analysis will need to be made in order to reach a conclusion:

Basis of Analysis

The following assumptions should be used as a basis for the analysis:

A. The pipeline facilities are located in a remote area of southern Chad.
B. Southern Chad has little infrastructure, limited local skilled labor, and lack of industrialization.
C. All rotating equipment, major electrical equipment, tagged instrumentation, and bulk structural steel will be purchased from outside Chad.
D. All fabricated equipment and remaining bulk materials will be purchased for the most part outside of Chad.
E. It is unknown if module fabrication will be performed predominantly in Chad Fabrication Yards, but in any case will still require both sea and land transportation.
F. Engineering will be performed outside Chad.
G. Chad will not impose a limitation on visa's for TCNs which comprise the construction labor force.

Cost Impact of Modularization Drivers

Based on a general rule of thumb, for every $1.00 saved in labor, material cost will increase by $2.50 to $3.00. Once we get a Level 2 cost estimate (equipment-factored) for the Doseo pipeline facilities, we can look at the equipment and material costs versus the labor cost and develop a factor in order to assess the taking into account of Chad and TCN labor rates and productivities.

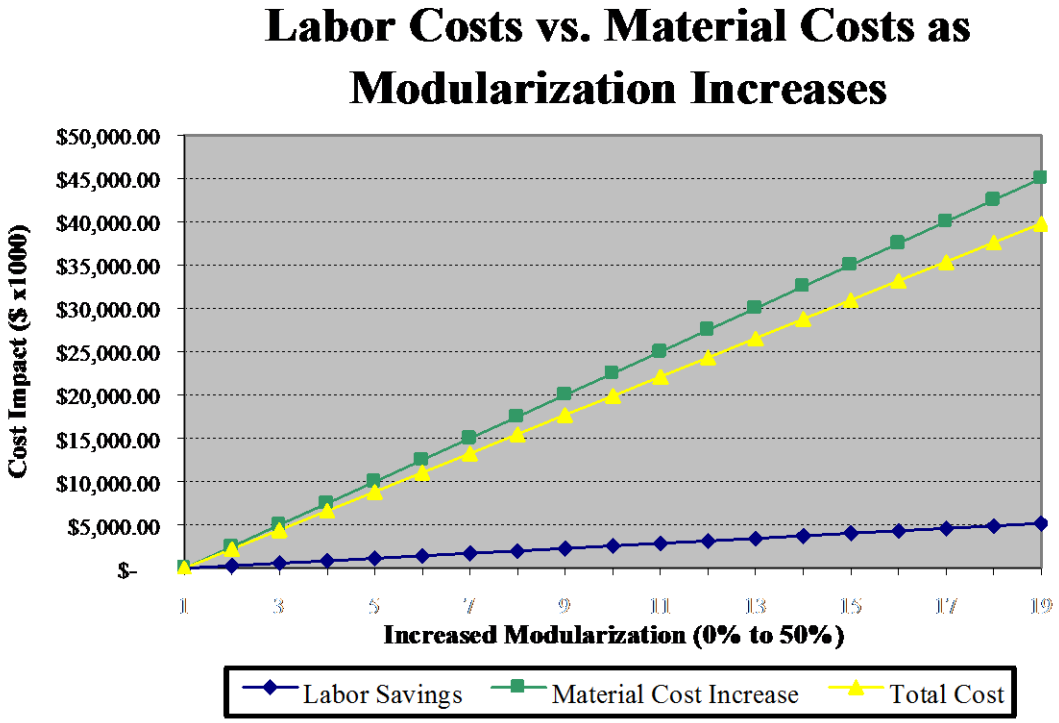
The increase in material costs referenced can be attributed to several factors. As modularization increases steel quantities increase due to the requirement of larger steel shapes and more steel members and bracing. Larger steel shapes are required to support the increased weight due to the increased amount of pipe spools, equipment, electrical and instrumentation within the modules. As the modules increase in size, the spans increase as well. The increased spans contribute to the requirement of larger structural steel shapes and correspond to increased lengths in steel members. As the amount of structural steel increases, bracing and miscellaneous steel will increase accordingly. The increased number of modules will also require additional blocking and bracing for transportation purposes, further contributing to the increase in steel quantities.

As modularization increases pipe material costs increase due to a greater percentage of shop fabricated spool pipe and a corresponding increase in the use of fittings. Theoretically, the size and length of the pipe should not change. Larger and longer modules will also increase the requirement for pipe supports and shoes within the module, further contributing to the module weight, but potentially reducing the field requirements for the same.

Electrical costs will be impacted due to an increase in junction boxes, conduit and terminations. Theoretically, total lengths in cable and wire should not increase substantially, nor should the instrumentation count.

Piling will be used for foundations. As such, concrete costs for pile caps & foundations should not change and may decrease. As weights increase, causing foundations to slightly grow, quantities may increase. To some degree, the growth changes should cancel each other out, which past experience has observed as well.

Freight costs will increase as the number of modules and bulk quantities increase. Based on the perspective that steel will be purchased and shipped from the same location and vendors, whether the project is modularized or stick built, the impact of who supplies the steel should not be a factor, but a constant. As material quantities increase, the amount of corresponding freight will increase proportionally. The overall distance the bulk materials and equipment will be shipped will vary based on the proximity of the suppliers and vendors to the module fabrication yards and the rate of quantity growth, but should not drastically change. However, the completed modules will require additional freight due to the additional distance and complexity of the transportation. The heavier modules will require additional heavy hauls and increase lifting equipment costs. Ocean freight of the modules, if required, will become more expensive as the weight and size of the modules increase. A graphical representation of the principles follows.



Past analysis and experience have shown that the following increases could be observed as percentages of total project quantities:

Steel Costs:	Increases 15% to 45%
Electrical Costs:	Increases in the order of 10%
Pipe Costs:	Increases in the order of 10%
Paint & Insulation:	Increases in the order of 15%
Freight:	Increases 15% to 50%

Space Limitation, as previously stated, is not a consideration for the Doseo pipeline facilities. However, as modularization increases, the space requirement will decrease. The reduction in space savings will be dependent upon the design of the modules. As the modules increase in height, the footprint can reduce by an undetermined amount. Increased module height in turn may increase module weight, which impacts the infrastructure requirements and transportation equipment requirements. Roadway height restrictions should not have an impact the module height however.

Space limitations may limit the amount of labor is capable of working on a particular effort. Modularization can be a solution, which allows workers to progress on a particular unit at any given time, by focusing on independent activities in separate locations. Yet, as stated before, the Doseo pipeline facilities is not deficient in space availability at this problem at this time.

Safety, Permit Limitations and Commercial Impact for Time to Market are not considerations that drive modularization here. Reasoning will derive that as project site safety becomes more of a consideration, safety practices, PPE, and additional personnel will increase field costs. Consequently, if safety concerns increase, shop fabrication may become more attractive and perhaps more economical.

Additional Cost Considerations

A general analysis of the Doseo pipeline facilities will need to be done, based on dollar value, to determine what equipment is or is not suitable for modularization due to their size and/or weight. An example would be storage tanks.

The impact of modularization on Home Office costs will be some increase the engineering and procurement costs. Previous analysis has noted that engineering and design costs could increase up to 10%, while procurement costs can increase up to 20%. While these increases could be lower, the skill and experience of the engineering and procurement personnel will determine to what degree these additional costs are diminished. The increased costs can be attributed to the increased complexity of the engineering and design required by a modularized unit versus a free standing stick built unit. Procurement efforts will become more complex as well due to the additional coordination required between vendors, mills and fabricators.

Project Management costs saved in the field will be off-set, in part or in whole, by additional inspection and coordination personnel at the fabrication yards.

As noted earlier, infrastructure costs should be a consideration. Based on the assumption that the Straddle Plant is in a moderately industrialized area, the improvement and maintenance costs required should be considerably less than an undeveloped area. However, narrow roads and bridges, short bridge clearance heights, weak bridges, traffic congestion or poor quality road surfaces may demand improvements and maintenance, which will be compounded by heavier, wider and taller module loads. Though a cost or percentage increase has not been determined, it stands to reason that the increased cost could be substantial. If new road surfaces or bridges are required, the costs will increase substantially with each major improvement.

Modularization should produce gains in the area of quality and field rework. Though a hard dollar amount may be difficult to apply to the value of quality, the value still exists. However, the

increased complexity of the modules will realistically increase rework in the fabrication yards, which would diminish the returns of the quality gained and field rework avoided in the field. One could reason that field rework and testing would decrease on the whole, but potentially increase as a percentage of field labor due to the decrease in field labor. The increased percentage of rework could be caused by complications due to mating, hookup or interconnection of modules, particularly if they are designed and fabricated by separate engineering firms and fabrication yards.

Chad content will need to be addressed and factored into the modularization decision.

Path Forward

It would appear that modularization of the Doseo pipeline facilities is justified unless the knowledge and assumptions of the project drivers is not correct (for example: if Chad were to restrict availability of TCN craft resources).

We need to instruct our FEED contractor (or possibly EPC Contractor) from a Glencore perspective of the drivers to a modular approach. Generally, the steps and primary FEED deliverables of this effort would include:

- Assess the impact of different prefabrication cases on cost, schedule, and plans for the project. (Requires access to basic engineering documents such as equipment specifications and plot plans / layouts.) This would also include assessing the impact on layouts and access to the completed facilities.

- With an approach defined and approved, develop a program wide pre-fabrication strategy and plan. This effort would produce schedules and execution plans that define how all participants are impacted by the plan.

- Develop the Program Prefabrication Criteria that define the extent of prefabrication including modularization, impact on specifications for design and fabrication, logistic needs and requirements, and construction requirements.

Our FEED contractor may have or can develop flow charts for the work process and example evaluations / plans / criteria that can be reviewed and used to support discussions so that we can make a quality decision regarding modularization.