



(RESEARCH ARTICLE)



Challenges and causes of delays in oil and gas construction in the Niger-Delta Region of Nigeria: A case study of the Southern Swamp Associated Gas Solution Project (SSAGS)

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Abstract

Timely delivery of onshore oil and gas construction projects has been a significant challenge for many oil and gas construction companies operating in the oil-rich area of the Niger Delta. The region, characterized by wetlands and water bodies with creeks and river crossings, became the home of many International Oil Companies shortly after Oil was discovered in 1956. Because the region is hospitable and blessed with Petroleum resources, most operating companies need to pay more attention to the terrain in the area before engaging in full exploration. This paper examines the challenges and reasons for delays in onshore projects and makes recommendations that should be adopted to enhance the speedy delivery of projects. It is a case study of the Southern Swamp Associated Gas Solution Project of Shell Petroleum Development Company, Nigeria.

Keywords: Southern Swamp Associated Gas Solutions (SSAGS) Early works; Foundation; Oil and gas construction; Soil investigation

1. Introduction

The Niger Delta, located in the central part of southern Nigeria, is a region of immense significance to the global oil and gas economy. Covering a total land area of about 7000 km², it is Africa's largest Delta [1]. Approximately one-third of the wetlands' land area contains the world's third-largest mangrove swamp forest. The Niger -Delta, Nigeria's oil and gas belt, is the home of over 28.9 million Nigerians. [2]. The region covers over 1481 oil wells and an estimated 159 fields linked by more than 7000km of pipeline with approximately 275 flow stations operated by 13 Oil companies. [3]. Despite its strategic usefulness, it is plagued by frequent schisms within communities, conflicts between communities and multinational oil companies over oil extraction activities, and, more recently, between radical groups within the region.[4]. Oil occupies an essential place and plays a pivotal role in Nigeria's economy. According to Obi (1997), oil accounts for 95% of export earnings and over 80% of national revenue [5]. Oil revenue growth in the past few years greatly influenced the activities of Oil and Gas construction companies in the Niger Delta. It is a fact that early revenue generated from the Oil and Gas exploration enabled Nigeria to prosecute the thirty months of Nigeria's civil war without any form of external borrowing. Hence, there is a sense in which it could be argued that the issue of who controls the nation's oil reserves was part of the underlying factors that ignited the Nigerian Civil War.

2. Southern swamp associated gas solution project

Oil and Gas business in Nigeria involves both private and public participation. The private are the oil companies operating within the region of Niger Delta. At the same time, the public and various state agencies are involved in monitoring and controlling oil and gas exploration in Nigeria. Such agencies include the Department of Petroleum

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Resources (DPR), National Petroleum Investment Management Services (NAIPIMS) and Nigerian National Petroleum Corporation (NNPC) [6]. The Southern Swamp Associated Gas Solution was initiated in October 1999 with a mandate for further oil development and reducing routine flaring at flow stations. This area comprises 16 fields (12 producing fields and four partially appraised fields) (PAFs) and four unappraised developments (UADs) with Scope for Recovering (SFR) volumes in the order of 858MMboe. The fields are in OMLs 35, 36 and 46 in the Coastal Swamp area, 65 nautical miles south of Warri in the Niger Delta. The philosophy of Southern Swamp, Associated Gas Solution, is to gather all existing production fields together in four locations, Tunu, Ogbotobo, Benisede and Opukushi, where it will be transported through the Trans Ramos pipeline to Forcados Terminal while the associated gas is flared. The cardinal point of the Southern Swamp Associated Gas Solution Project is basically to modify the existing flow stations located at Benisede, Ogbotobo, Opukushi, and Tunu and also to install a new gas Centralized Production Facilities (CPF) in Tunu, which is to gather all Associated Gas flared at the moment. At the same time, the NAG/AG (Non Associated Gas /Associated Gas) goes to the domestic market for consumption. The overall development concept and locations where construction works will be carried out are illustrated below:



Figure 1 SSAGS, Benisede site before construction



Figure 2 SSAGS, Opukushi site before construction

SSAGS Has four locations: Tunu, Benisede, Ogbotobo, and Opukushi. All the location belongs to the Ijaw-speaking area of part of the Niger Delta, and the indigenes are predominantly fishermen.



Figure 3 SSAGS, Ogbotobo site before construction



Figure 4 SSAGS, Tunu site before construction

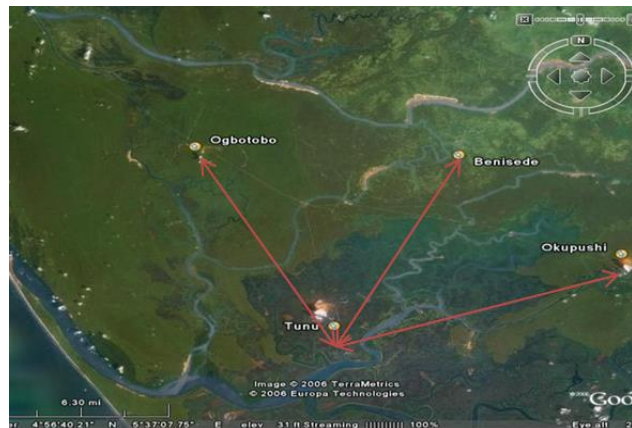


Figure 5 Project Site Location Distance Map

3. Construction early works

The construction phase begins with early works at different locations within the project. Before the early works activities commenced, the communities within the locations were actively engaged in peaceful project delivery. This community engagement is not just a formality but a critical aspect of project execution in the Niger Delta. It is a deliberate plan and sustained effort to foster and maintain mutual understanding between the organisation and its community. Any activity that establishes and maintains understanding between a business firm and its operational

community falls within the orbit of community engagement or Interface [7]. The early work comprises the below activities at the four locations.

- Site Preparation (SP)
- Bush Clearing
- Soil Investigation
- Dredging Works

4. Site preparation

The purpose of site preparation and visit within the Niger Delta can never be over-emphasized. Site visits are vital in oil and gas field development in both onshore and offshore locations. It also helps in a practical and consistent constructability strategy before construction activities commence. The pattern of settlement in the Niger Delta is primarily determined by the availability of dry reclaimed land and the nature of the terrain. One of the significant advantages of proper site visit and preparation is to create awareness of the existence of production interest within the host community. It also highlights unforeseen challenges before mobilisation to the site. In the Niger Delta region, most visits are accompanied by Military Patrol Vessel (MPV) to ensure the security of personnel and also for proper study of the routes to the project site. Most international oil companies operating within the area can also use helicopters for major site visit operations. In all, the primary purpose of every site visit is to foster good relationships with the community stakeholders, thereby engaging the services of the community through boat hiring and surveillance operations.

5. Soil investigation

According to ASTM D 420, a site investigation is to identify and locate both horizontally and vertically significant soil, rock types and groundwater conditions present within a given site area and to establish the characteristics of the surface materials by sampling or in-situ testing or both to be used for evaluation of foundation types[8]. It required that the geotechnical investigation of Southern Swamp Associated Gas Solution project locations must have a complete description of subsurface conditions and the results of in-situ and laboratory tests to contain exploration boreholes, soil profiles across the site, In-situ test records, e.t.c. The investigations in SSAGS locations were carried out through Boring, Geophysical Survey, Penetrometer and Laboratory tests.

The SSAGS project sites fall within the Nigeria Geological formation called “Meander Belt of Wooded Black Swamps and Freshwater Swamps “, made up of sands, gravel and clays. Most sediments originating from a vast and geological complex hinterland are dispersed through the delta by river flow, tidal waves and ocean currents. The oldest strati graphical unit of the deltaic plain is sand (old sand), representing a marine transgression into the hinterland. The geophysical survey undertaken at SSAGS locations includes the Electrical Resistivity Test, Soil thermal Resistivity and Redox Potential Movement. Data for these experiments conducted in Tunu, Benisede, Opukushi and Ogbotobo of SSAGS project locations were collected from KD2 Pro Thermal Property Analyzer and HANNA H1 9025c microprocessor PH/ORP of high precision.



Figure 6 Bore Hole Drilling for Geotechnical Works at SSAGS Project location



Figure 7 Geophysical Survey works at SSAGS Project Location.

Most oilfield infrastructural development in the Niger Delta region of Nigeria is often preceded by Dredging activity. Dredging activity is significant in the mangrove area of the Niger Delta, especially in locations with unstable topography. Dredging in sensitive ecosystems may have a severe impact if not well managed, but handling / management of resultant dredged material is of more significant concern in Niger –Delta.[9]. Before the commencement of the Dredging operation in SSAGS project locations, a preliminary report of a sand search conducted showed adequate sand for sand filling the Booster Stations of Tunu, Benisede, Ogbotobo and Opukushi sites to 4-7 km away from the Booster Stations. Indeed, it was a big challenge for the Project Management Team as most dredged material will be transported to the prospective areas. It then calls for a bound wall construction close to every dredge site to preserve the sand materials awaiting transportation. The Southern Swamp Associated Gas Solution (SSAGS) adopted the hydraulic sand dredging operation as the most acceptable method for dredging the locations. The Project Management Team also ensured that the dredging operation of these locations does not affect the livelihood of the people living around the dredged site. Indeed, an alternative source of living water was provided for the inhabitants of the locations as they claimed the operation was polluting their water.



Figure 8 Dredging Operation of SSAGS Project Location

6. Piling operation in the sags project

Piling operation is necessary for every facility construction in the Niger Delta region of Nigeria. Most soil investigations conducted in recent years have shown that adequate piling is required for oil and gas facility construction. In the Niger Delta region, statistics have shown that many oil and gas construction company spends 5-10% of contractor sum in carrying out soil investigation analysis. The piling system in the Niger Delta region must take into consideration the cost, schedule availability, locally available materials etc. After the successful completion of the soil investigation and the release of the favourable technical report, a trial pile installation was driven, and tests (PDA) were carried out after some days as stipulated in the procedure. Piles are driven into the ground by a rig that supports the leads, raises the

pile, and operates the Hammer [10]. A strength test must be conducted to determine the Integrity of the pile before foundation work begins. The dynamic wave analysis method predicted pile strength and static soil resistance distribution. It was observed that driving effects decreased the skin resistance in the clay layer, which was not allowed to be set up before loading for static load testing. Correction between the static load test and simulated static load prediction would be possible if the static load test were performed on the pile before restricken for PDA. The data required for the above test was obtained from two strain transducers and two accelerometers attached to the piles at 600mm from the top.

Table 1 SSAGS Pile statistics (Source: SCNL 2014)

Locations	Precast pile	CFA Piles	Total
Tunu	1024	202	1226
Ogbotobo	394	45	439
Opukushi	461	173	634
Benisede	488	36	524



Figure 9 Piling operation at SSAGS Project Location

7. Civil foundation

The civil phase of any oil and gas construction project is usually a milestone for the contractor. In most cases, it is regarded as the pillar of the entire project. However, in the Southern Swamp Associated Gas solution in the Niger –Delta region, the civil foundation phase was significant in the project. An accurate and precise construction strategy is usually applied in this project phase. Oil and gas construction companies try to avoid mistakes in this phase as much as possible because it is always costly and sometimes damages the company's reputation.

8. Design and construction philosophy of the sags project

The Southern Swamp Associated Gas Solution Project design philosophy was based on retaining all the existing flow stations and, as much as possible, the existing infrastructure to improve the project delivery schedule and reduce cost impact. Still, the philosophy shall be maintained in line with the current on-land configuration. This shall be by the project objective and one of the business drivers of the project, "Maximizing the use of existing oil infrastructure (flow stations) to boost production." it is a unique one in sub-Sahara Africa. The existing flow stations, namely Tunu, Ogbotobo, Opukushi and Benisede, shall undergo a Brownfield upgrade to recondition their helpful life for the feed gas supply to CPF, where the gas shall be compressed, treated and conditioned for export to the domestic gas market. Unlike many other projects in the Niger Delta region of Nigeria, SSAGS is the only major project of Shell Petroleum Development of Nigeria (SPDC) in the western swamp area of Niger Delta that is to undergo retrofitting that will ensure remote operation capability opportunities are possible making unscrewed operation and the capability for remote shutdown from Tunu Central Control Room contingent on local permissive switches having been re-set locally.

9. Challenges in the southern swamp-associated gas solution project.

Unlike many other projects in the oil-rich area of the Niger Delta, SSAGS Project equally has its challenges and causes of delay in execution. Security was a significant challenge for the project, as the locations were all in the creek. Moving material to locations could take two to three days from the Field Logistic Base (FLB) in Warri. Materials do not arrive on time because all logistics, including the Military Patrol Vessel escort, must be put in place before embarking on any journey. In most cases, movement is delayed for days, mainly where security breaches and the Contractor still determine the reasons. No movement is allowed at night in any location, and sailors constantly communicate with the FLB during sailing. Because contractor personnel are essential to the project, personnel movement or River Crew Change (RCC), as it is called, can only be done on particular days with high-security intelligence and escort. The company's hired Helicopter can airlift most personnel who cannot go by water. Indeed, it is a requirement for personnel working on the project to have swimming competence, and likewise, those who go by air must have the required lifesaving training certification.

Another major challenge in the project is the youth and community restiveness. The fact that 23 communities are within the project location makes it more difficult for contractors to work for a few weeks without shutdown. It is the norm in the Niger Delta region for communities within project locations to express their desire for a better life, especially where the Government has failed. Most of these expressions come from protests, and many times, they have been addressed by the Community Affairs Department. In SSAGS, contractors recognise the importance of host communities and ensure they are treated fairly, irrespective of their demands, to avoid delays in project execution. The Global Memorandum of Understanding (MoU) between the stakeholders and the contractor clearly stated that the contractor must respect the rights of the host communities and abide by the laydown principles of engagement.

Oil and Gas construction activities in the Niger Delta region have always been challenging with construction companies operating there. Statistics show that most construction companies go into partnerships or consortiums to enable them to carry out their construction activities in that region effectively. Most of the time, the host communities request that operating companies within the area form partnerships with community contractors before they can operate. Such partnerships benefit the host communities as individual parties of the consortium are enforced to establish a different memorandum of understanding with the host communities. Hiring personnel and sub-contracting jobs to the host communities is agreed upon as it empowers the youth and the stakeholders, making them part of the project. The table below shows the communities and corresponding flow stations.

Table 2 SSAGS Project Host Communities

S/n	Community	Location
1	Egbemo-Angalabari	Opukushi & Tunu Fields
2	Agbidiana	Opukushi & Tunu Fields
3	Ojobo	Benisede field
4	Peretorugbene	Benisede field
5	Amabolou	Benisede field
6	Tamogbene	Benisede field
7	Oweigbene	Benisede field
8	Norgbene	Benisede field
9	Ogbotobo	Ogbotobo field
10	Agbayama	Ogbotobo field
11	Tonor	Ogbotobo field

It is also necessary that Operating companies within the Niger Delta region, on completion of onshore projects, leave the area better than it was. When companies fulfil their social and civil responsibilities to their host communities in all sincerity, they live longer in the minds of the stakeholders. Hence, it will bring about mutual co-existence in the future.

10. Construction delays in Niger-delta

Oil and Gas Construction project in Niger Delta is prone to delays. Most times, delays begin from conception to detailed design and construction. The construction industry in Nigeria has this to battle with, and despite analysing these causes of delays by project managers, most projects still need to be finished on time. The problem is a global phenomenon, and the construction industry, especially Oil and Gas Construction in Nigeria, is no exception. Delays mean projects can only be completed at a later time. For a contractor to stay active in the competitive industry, stakeholders and clients expect the contractor to perform above average, completing the project faster, cheaper and with a high degree of quality. Every contractor trying to minimise risk and cost and delay in the project will lead to a loss in production and revenue. Construction projects have a great deal of preoccupation with increasing safety and regulatory requirements, technological & quality aspects, changing socio-economic environment, scope modification and increase in cost with time due to inflation and escalations, which hurts the project performance [11]

11. Primary causes of delay in the SSAGS project

Delays experienced in the Southern Swamp Associated Gas Solution Project of Shell Petroleum and Development Company in Nigeria can be classified into the following groups;

- Building and Construction Related
- Design Related
- Contract Related
- Project Management & Administration
- Government Policies.

The majority of the delays in projects within the Niger Delta region are construction-related, which the SSAGS project is never an exemption. Despite the constructability studies conducted within the four locations of the project site, construction-related issues still need to be overcome. Many construction mistakes were observed, from foundation works to steel erection. The area's topography is equally contributed to, as the soil needs more stability and settlement for proper foundation. Most equipment deployed to the site for construction purposes is similarly unsuitable for swampy areas and, hence, frequent equipment breakdown. Since the construction industry employs more unskilled and semi-skilled labourers, the tendency for mistakes during the project's construction phase is always high without proper supervision. Hence, it is a requirement in Southern Swamp Associated Gas Solution (SSAGS) that at most 15 unskilled or semiskilled workers are under the supervision of a skilled worker.

Some causes of delays in the SSAGS Project were never construction-related. Construction activities indeed proceed with design in stages. It is much easier to make changes during the design phase of a project than during the construction phase. The project's construction phase involves much more capital than the design phase. Design-related issues in SSAGS were different from expected because measures will be implemented. However, a few design challenges were at the client's request, and changes in drawings with discrepancies in the design document were attracted. Design delays can never be over-emphasized, unlike in other regions in Nigeria. In the SSAGS Project, changes in design were seen as a process that required urgent attention. Design delays are classified as significant delays, and if detected early, can protect the project from further delays. Design delays are due to many factors, such as environmental challenges, absence of required material, and interference with other structures or objects.

Another delay faced in the Southern Swamp Associated Gas Project was the issue of contract implementation. Most oil and gas companies demand full implementation of contract terms by the contractors irrespective of the challenges faced by the contractor in project execution. Despite the existing signed agreement with the communities by the Shell Petroleum Development Company of Nigeria, the host and impacted communities will likely demand special consideration in the planning and execution of the project. Managing the host communities' stakeholders generated a series of meetings that often ended poorly with the contractor. Communities generally insist that contractors are corporate entities and are obliged to carry out Corporate Social Responsibility in communities where they operate and make a profit.

The contractor's project management team of the Southern Swamp Associated Gas Solution (SSAGS) project is mandated to control the overall management, planning, resourcing, execution, cost monitoring, scheduling, documentation, and quality, with the health and safety of the entire project. It is a notable fact that Project management administrative work causes delays in project activities. The fact that the project management team of SSAGS do not meet daily to discuss progress issues invariably means that some changes that need urgent approval of the management do

take some days or probably weeks, resulting in delays in activities. However, the construction manager may make some decisions depending on the cost implication; approval may need to come from the project management team.

The Niger Delta region of Nigeria is susceptible, and every government policy towards the region is watched with keen interest. The region's inhabitants have yet to benefit from the region's immersed natural resources. Most oil and gas companies in the region do not carry out their Corporate Social Responsibility (CSR) to their host communities, creating unruly behaviour among the youth and leading to militancy and other social vices. However, many of the government policies of the region receive delays in approval and thus affect the construction projects within the region. Approval for dredging operations outside the Niger Delta region may take two weeks, but within the Niger Delta region, it is expected to take two months. No doubt, this will affect the overall planning of the project.

12. Conclusion

Delays in oil and gas project construction in the Niger Delta region not only affect the project's operators but also has a significant impact on the inhabitants of the area. More resources are spent, such as when projects are delayed in any region. Waste accumulation increases, creating pollution and unhealthy situations for the people. The following steps should be adopted for significant oil and gas contractors in the Niger Delta region to ensure that delays are not observed in their operations.

- The appropriate authority should speedily approve changes observed during construction. Management of Change (MOC) should not take more than one week.
- More skilful and competent personnel should manage key areas in construction activities. Technical ability should be the highest priority during employment, irrespective of any condition.
- The government should facilitate the approval of operations for contractors in the region. This is to ensure that projects are completed as scheduled and that demobilising the contractor from the area is completed as planned to avoid unnecessary costs.
- All design activities should be treated on-site by the facilities' operators. The fact that most contractors in Niger Delta have their design offices outside their operation sites makes it difficult for workers on-site to be informed on time. Drawings should be reviewed on-site, and changes should be implemented with revision codes and standards. This will help the process and reduce the delay in the project.

Construction companies operating in the Niger Delta region should encourage flexibility in their contract by accommodating relevant parties and carrying out community engagement whenever they have contractual issues. Host communities should apply dialogue rather than encouraging work stoppage by their youth.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare they have no conflicts of interest or financial conflicts to disclose.

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