Netherlands Commission for Environmental Assessment

Observations on the Tullow Jubilee Phase 1 Development EIA Report (2009)

Memorandum by the NCEA

October 2009

Advice of the Secretariat

To	Environmental Protection Agency (EPA), Ghana
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From	Ms Ineke Steinhauer (The Netherlands Commission for Environmental Assessment, NCEA), with expertise input from Mr. Maarten Jan Brolsma (oil and gas development)
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Subject	**Observations on the Tullow Jubilee Phase 1 Development EIA Report (2009)**
	By: Secretariat of the Netherlands Commission for Environmental Assessment – with expert input from oil and gas expert
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1. INTRODUCTION

By e-mail communication on 22 September 2009, the EPA-Ghana indicated that it had received the Environmental Impact Statement on the Jubilee Oil Field Phase 1 Development and that is was in the process of organizing the review of the statement. The EPA Executive Director has requested the NCEA to review the report and provide EPA with necessary technical support and advice. The report can be accessed from the EPA website. The same request has been done to the Norwegian Ministry of Environment.

2. APPROACH

In order to perform a good quality review advice, 'normally' NCEA would establish a working group of experts, plan a site visit and undertake the review jointly with the EPA technical review committee (as NCEA has done before together with EPA for e.g. the West African Gas Pipeline project). However, in this case time availability is limited, and moreover NCEA came in late in the process because it had not been involved in previous review activities of this EIS. A desk review of the EIS would be another option, but would equally require substantive NCEA input (given the bulky amount of EIS documents) in order to be able to meet NCEA's own standards in terms good quality review. Therefore a desk review would be restricted to comments on main issues only.

NCEA also contacted the Norwegian Ministry of Environment to find out about how they would comment on the EIS and how coordination could best take place. It was agreed that on basis of the findings, it will be decided whether comments will be sent separately or jointly to EPA. In any case, findings will be shared before these will be sent to EPA.

On 28 September, EPA communicated by e-mail that the desk review option appeared to be the most feasible given the time at our disposal and that they liked working with the Norwegians on this.

The observations, conclusions and recommendations from chapter 4 onwards relate to headlines only. Time did not permit an elaboration in detail.

3. THE INITIATIVE

The Jubilee Field is situated 60 km from the coast of Ghana in water depths between 1100 – 1700 m and covers an area of 110 km². An EIA has been carried out by ERM of South Africa on behalf of Tullow Ghana Ltd and is restricted to Phase I of the Plan of Development.

This EIA process is mainly concerned with:

- the installation of production facilities at sea in the form of a Floating Production, Storage and Offloading (FPSO) vessel and
- subsea well heads, production manifolds and rigid and flexible pipelines
- the subsequent operation of the field involving the production of oil and gas,
- the processing of these products,
- the cleaning and discharge of the associated production water and
- re-injection of the gas, production- and seawater in the original reservoir to boost oil production
- the offloading of the oil in export tankers once every 5-7 days and
- the possible future transport of gas to shore by pipelines.

The development drilling programme has already been covered by three separate EIS (covering amongst others the discharge to sea of the ditch cuttings) and have been approved by the Ghanaian authorities. Drilling is currently underway and expected to be completed by mid 2011.

Some 17 wells will be drilled of which 9 are producing wells, 5 water injectors and 3 gas injectors. First oil is expected by October 2010. The lifetime of the field is expected to be at least 20 years after which the installations will be decommissioned.

This development is in accordance with the 2006 2nd edition medium-term national development strategy known as the Growth and Poverty Reduction Strategy (GPRS II) 2006 to 2009. The strategy places emphasis on economic growth as a means of reducing poverty. Two priority areas will benefit, i.e. infrastructure development and private sector development. Income will be generated through sale of the State´s share of the oil, taxes and royalties.

4. MAIN CONCLUSIONS

The EIA process for the Jubilee Phase 1 Development project has been carried out in accordance with the Ghana Environmental Assessment Regulations (LI 652, 1999) as amended (2002).

The "Impact Assessment Process" covers the main issues of concern listed in Chapter 3 above and follows industry standard practice. A complete lifecycle analysis covered all activities that are a necessary part of the Phase I development (from well completions through production and processing to abandonment and decommissioning). The application of the What, Where, When and How approach allowed full evaluation of potential impacts to environmental resources and social receptors. This process also assured early identification and consultation with a range of stakeholders including government bodies and community representatives to identify key issues and sources of information. For the FPSO, risk identification and measures to reduce the risks according to ALARP principles have been adequately carried out through an in-situ HAZID, Quantitative Risk Assessment, Collision Risk Assessment and structural amendments in construction and operational procedures.

Monitoring of all the proposed mitigating measures is mainly carried out internally or by externally hired auditors. Government EPA officials should form part of such verification procedures to assure compliance with the planned modes of operation but equally to increase skills and awareness within the EPA and Ghana Administration.

In view of the proximity of the East Atlantic Flyway and the known casualties lighting on platforms causes in the North Sea, monitoring of the impacts of lighting on bird migration in spring and fall is recommended.

The recent developments in the oil and gas sector in Ghana and neighbouring Cote d'Ivoire, need a serious look at cumulative effects of all these activities off- as well as onshore on both the physical environment and the socio-economic environment. The most important strategies that could help manage potential future cumulative impacts as outlined in this EIS are:

• Strategic Environmental Assessment (SEA). A government led SEA would enable a comprehensive consideration of potential impacts that may result from the development of the oil and gas sector in Ghana. Such an assessment would ideally feed into the key elements of proactive planning (land use zoning, analysis of infrastructure, waste management, utility and social service needs). The assessment would require greater information on the types of development than is presently available.

• Build Capacity of Local Administration. The support provided to Regional and District government to build the capacity of its staff would determine the extent to which it is able to plan effectively for future development in the area. Administrative capacity building could include training, provision of equipment and the provision of technical support (e.g. information technology support). General capacity building is typically government led (sometimes through donor assistance) but industry can play an active role in developing technical capacity for oil and gas sector oversight.

This Draft EIS is considered by the NCEA as exhaustive but thorough and of good quality. The recommendations to manage future cumulative impacts are fully supported.

5. EXPLANATORY NOTES AND RECOMMENDATIONS

5.1 Legislative and Procedural Setting

The development of the Jubilee Field has to comply with Ghanaian regulations as well as international rules and regulations. Ghana is signatory to most international conventions (ABS, IMO, OPRC, OSPAR and MARPOL) covering the operation of the FPSO including adequate measures for dealing with major incidents or threats to marine pollution and water quality standards. MARPOL stipulates that a mono-hulled FPSO needs "appropriate measures" to mitigate the risk of low energy collisions between the FPSO and other vessels. The project has also adopted the standards of the International Association of Oil and Gas Producers (OGP) (former E&P Forum) as industry good practice standards for environmental assessment and management.

5.2 Environmental Impact Assessment

A description of the baseline is crucial to identify resources and receptors as having the potential to be significantly affected by the project. Where possible quantifiable data have been collected. In 2008 an environmental baseline survey assembled data on physico-chemical parameters and benthic faunal communities of the sediment and physico-chemical characteristics of the water column between 1800 to 16 m in the vicinity of the Jubilee Field. Phytoplankton biomass concentrations were measured and the composition and density of the planktonic and benthonic communities was investigated. Seasonal variations have been recorded. Bird migration routes have been included. Of the 6 Important Bird Areas, one (the Amansuri wetland) is located within the project sphere of influence. Mangroves occur only in the East of Ghana, outside the zone of influence of the project.

5.3 Socio-Economic Assessment

The Socio-Economic Baseline study was mainly concerned with the Western Region of Ghana, where 5 ethnic groups comprise the population. The population is for 55 % employed in agriculture, 15 % in mining and 11 % in manufacturing. Tourism is becoming a major socio-economic activity and one of the most important and fastest growing sectors.
In 2000 a census indicated 53 % of the population above 15 years to be literate in either English or a major Ghanaian language. Males in the Western Region have a higher literacy rate (68 %).
Stakeholder consultation started at the scoping stage and will continue during the lifecycle of the project. A Public Consultation and Disclosure Plan

(PCDP) was developed for the EIA phase of the project. Consultations included NGO´s, fishermen, national and local government stakeholders.

During the consultation process macroeconomics, social investment and employment opportunities were the key issues of concern raised.

The project operations are primarily located offshore and there will be few direct interactions with other human activities other than limited numbers of other marine users who operate in the area such as commercial vessels passing through the area and deepwater fishermen targeting pelagic fish such as tuna.

Information on how the government would use the revenues that would accrue to them is not defined and is outside the control of the project, so the direct socioeconomic benefits cannot be fully determined in this EIA. Where Tullow can influence expenditure at the macroeconomic level is through the establishment and financial support for projects through its own Corporate Social Responsibility (CSR) strategy and in sponsoring training programmes/education in the oil industry. The CSR initiatives are likely to build on the support to water supplies from water wells, vaccinations and school refurbishment projects have already been carried out since 2007.

Tullow are developing a Human Resource Strategy for the recruitment, training and development of national staff in its operations (known as 'nationalisation'). Direct employment by Tullow and indirect employment through contractors and suppliers will have a positive impact on those people employed, their families and their local communities from wages and other benefits.

Activities at the onshore supply and transport base have the potential for both positive and negative impacts on surrounding communities. The environmental and social performance at the shore based locations that Tullow operate in (port area and Air Force base) will be covered under Tullow Environmental, Health and Safety Management System (EHSMS).

5.4 Impacts on Fisheries

The Jubilee field is in a deepwater offshore area and the water depth at that location precludes trawling or other bottom fishing activities. Therefore, fishing for oceanic large pelagic species using passive gear (long lines) and active gear (pole and line, purse seines) is the only fishing activity in the area. Fishing vessels will not be able to fish within the exclusion zones for safety reasons. This will reduce the available fishing grounds within the Ghanaian EEZ and will affect those fishermen who operate in this area. Given the area available to fish for the target species in this location, exclusion from a relatively small area around the project site is not likely to significantly affect catches. Tullow will employ a Fisheries Liaison Officer (FLO) to liaise between fishermen and Tullow and to provide information to fishing communities, regarding Tullow's activities and the requirements to keep away from the operations for safety reasons. The FLO will also deal with any claims for gear damage.

5.5 IFC funding

Because several JV partners in this development have sought funding from the IFC, they must adhere to a series of 8 Performance Standards including:

- Social and Environmental Assessment and Management Systems
- Labour and Working Conditions
- Pollution Prevention and Abatement
- Community health, Safety and Security
- Biodiversity Conservation and
- Sustainable Natural Resource Management
- Policy on Social and Environmental Sustainability
- Policy on Disclosure of Information

A Corporate Social Responsibility (CSR) policy and strategy will assure the project activities to be undertaken to best industry standards and in a socially responsible manner.

5.6 Alternatives

During the design concept phase of the project, the project team evaluated a number of alternatives before defining the final project design. The evaluation of alternatives took into account safety, engineering, technical, financial and environmental considerations with the final choice being based on the option that provided the best overall performance against these criteria.

It is a requirement of the Tullow Environmental, Health and Safety Management System (EHS MS) that a hazard and risk assessment is integrated into all stages of the project lifecycle, including project definition, selection, implementation and operation. The Safety Case approach considered the following main project alternatives:

- Development Approach
- FPSO Design
- Mooring System
- Gas Utilisation
- Shore Base

The Safety Case includes various Formal Safety Assessments (FSAs) and Hazard Identification/Hazardous Operations (HAZID/HAZOP) studies of risks such as explosion, fire, dropped objects, ship collision and gas release.
Outcomes of these studies are integrated into the design through mitigation measures or Safety Critical Elements (SCEs) which are monitored against Performance Standards during field life. The Safety Case is updated as the control measures are tested and verified and during the field life as the risk profile changes or modifications are made to the facilities. The Safety Case will be submitted to a third party for verification.
For the Jubilee Phase 1 project a key mitigation measure for the project selection and design phases has been to use proven technology, systems and implementation methods which have been successfully used in other parts of the world.

After due consideration of various development scenarios, the preferred option comprises a continued field appraisal drilling programme to delineate field size and with phases of development initiated by a large (120,000 bopd) Phase 1 FPSO linked to a subsea well layout. This option met the

requirements of no continuous gas flaring, satisfactory reservoir management to protect and maximise oil reserves (gas and water injection at field start-up) whilst providing a relatively rapid first production schedule. The phased approach allows a development plan to be put in place for the first phase with later phases of development being optimised using the reservoir data from the first phase, including the actual production response of the field to extraction and injection. This phased approach to major investments mitigates financial risks and is common practice in major oilfield developments.

The choice for a turret-moored FPSO was based on:

- water depth;
- remote location of the field (remote also to any other infrastructure such as any oil pipelines) leading to a relatively high storage capacity to limit the number of export tanker visits;
- areal extent of the field not permitting a centralised drilling platform;
- safety and environmental performance (specifically a turret moored FPSO weather vanes in alignment with current and wind conditions reducing collision and oil spill risks during export tanker offloading operations);
- is a proven method in similar fields worldwide.

For the Jubilee field a tanker conversion of a single hulled Very Large Crude Carrier (VLCC), originally built 1991, was selected. Double sided hull configurations (usually new build FPSOs) are normally used where conditions demand a specialised vessel, generally with increased or specialised storage capacity, or where harsh environmental conditions exist such as the North Sea or Australasia. In West Africa approximately 20 percent of FPSOs are double sided.

When selecting the type of hull best suited to a particular location and project the following considerations apply to management of double hulls (OGP, 2001):

- Double hulls can be more prone to thermally accelerated tank bottom corrosion.
- Double hulls may operate to higher stress levels causing future fatigue problems.
- Double hulls are more difficult to conduct inspections.
- There is a higher potential for explosion in double hull ballast tank due to leaks between hulls where there is more tank spaces and more complex confined geometry.

A third party quantitative risk assessment (QRA) study was undertaken of collision hazards and risks from vessel traffic around the FPSO such as supply ships, incoming offloading tankers. The study considered the metocean conditions in the Jubilee field, the shipping traffic density and type in the region and scenarios of powered or drifting craft/vessels. The ship collision studies found that unmitigated collision risks (i.e. without the protection measures designed into the operations) with the potential to breach the selected single hull were very low (once in 5,300 years) with negligible risk reduction benefit gained from having a double hull or double sided FPSO with respect to these likely collision risks (once in 6,300 years). Moreover, pneumatic rubber fenders known as 'Yokohama fenders' and water ballast and slop tanks will be installed where alongside supply vessel operations will be conducted to provide double sided protection for some parts of the oil cargo holding tanks.

5.7 Seafloor Disturbance

Seafloor disturbance will be caused by the FPSO moorings and the installation of subsea production facilities, such as manifolds, trees, umbilicals, flowlines, injector lines, and riser bases. Some 2.3 ha will be affected. Mud mats will be used to prevent some installations (i.e. the Umbilical Termination Assembly (UTA)) to sink in the seafloor. Mud mats will measure 7.6 by 12.2 m, occupying an area of 93 m^2 each. Production manifolds will be mounted on suction piles equipped with short steel extensions that will penetrate the sediments to approximately 30 m (depending on the strength of the seabed sediments) and provide horizontal resistance to movement and stability.

5.8 Gas Utilisation

During Phase 1, an estimated 120 million standard cubic feet per day (MMscfd) of natural gas will be produced when producing the forecasted 120,000 bbl of oil per day (i.e. 1000 cubic feet per barrel of oil). The gas will be used for power generation and re-injection to stimulate oil recovery and preserve the gas for later development when the oil has been produced.

5.9 Flaring

No continuous flaring of excess hydrocarbon gases during normal operations is planned. Flaring will be avoided other than to maintain safe conditions. There will be intermittent flaring of gas during plant commissioning, start-ups and operational upsets and to purge the flare header to reduce explosion risk from oxygen ingress. The volumes flared will be metered to aid continuous improvement and monitor performance against goals for high gas utilisation. The clean-burn flare header system on the FPSO is designed to collect and safely dispose of high pressure hydrocarbons in the event of an emergency or operational maintenance/shutdown and facility start-up.

5.10 Production Water

The oil residue containing water will either be discharged overboard if the oil content in water is measured on-spec or else diverted back to the dirty slop tank. Specifications are according to:

1. World Bank IFC “Offshore EHS Guidelines for Offshore Oil and Gas Development”: 29 ppm monthly average; 42 ppm daily average oil content and no visible sheen.
2. Oslo-Paris Commission (OSPAR): 30 ppm maximum oil content or
3. US Environmental Protection Agency (EPA) Gulf of Mexico NPDES general permit (permit #GMG290000): 29 ppm monthly average; 42 ppm daily maximum oil content and no visible sheen

5.11 Fire and Gas Protection System

The active fire protection system and equipment will be designed in accordance with ABS Class requirements and provide early detection of any hazards, initiate appropriate mitigations (operational shutdowns and active fire suppression and protection) and facilitate the safe evacuation of personnel. The system is also designed to provide rapid automatic emergency shutdown and blow-down of gas inventories. Downhole safety valves will shut off production in case of emergency.

5.12 Oil Spill Impact Assessment

The risk of an oil spill (including crude oil and fuel oil) into the marine environment is inherent to all offshore oil developments. The likelihood (probability) of significant oil spills, i.e. those that can reach the coastline or other sensitive areas from FPSO operations is very low with most oil spills associated with offshore installations being very small and having only limited environmental effects. Sources of leaks and spills, frequencies and volumes have been modelled as input for oil spill modelling studies used to predict the consequences of the various oil spill scenarios in the event that a spill was to occur. Given the ecological sensitivity of much of the coastline west of Cape Three Points it is considered that the coastline is highly sensitive to impacts in the event of a large oil spill. Similarly, birds, turtles, marine mammals and fish and artisanal fishing in lagoonal waters are severely at risk if large volumes of oil are spilled.

Mitigation Measures
Mitigation of oil spills takes two forms: spill prevention and spill response.

Spill Prevention
1. Blow-Out Preventers (BOPs) permanently installed on the subsea wells
2. A system of wells, subsea flow lines, risers and FPSO topsides designed to international process codes and with alarm and shutdown systems to maintain the system within its design criteria at all times
3. The FPSO deck and drainage system will be designed to contain spills
4. Specific procedures will be developed for offloading crude.

Spill Response
Tullow has established an Oil Spill Contingency Plan (OSCP). Oil spills are defined according to three 'Tiers'. This classification is in alignment with the International Petroleum Industry Environmental Conservation Association (IPECA) which advocates a response to oil spills such that the planned response engages resources commensurate with the severity of the spill with the higher the Tier the higher the collateral response required.
Tier 1: The equipment held on the FPSO or other vessels where appropriate are likely to include portable skimmers, booms, deck storage, floating storage and dispersant spray sets for spills of approximately 5 tonnes.
Tier 2: In the event of a Tier 2 spill the initial response would be the responsibility of Tullow and would be organised from the FPSO. However, if the magnitude of spill warrants a further response it would engage mutual aid resources which may be leveraged from industry partners within Ghana and the Oil Spill Response(1) (OSR) West and Central Africa surveillance &

spraying aircraft from Accra airport. Mobilisation time to the spill site is approximately 3 hours.
Tier 3: In the event of a spill situation which is clearly beyond Tullow's immediate response capability, both mutual aid resources which may be leveraged from industry partners within Ghana and the OSR call-out guarantee from the Oil Spill Response Base in Southampton, UK. Mobilisation time of a Hercules Aircraft to Takoradi is 17 hours, with second aircrew involved so there is no requirement for a crew rest. Worst case scenario is 27 hours, which would include a 10 hour crew rest and 5 hours refuelling.

The Oil Spill Risk Assessment is realistic and involves a worst case scenario. Mitigating measures are according to international industrial standards.

5.13 Emissions, Discharges and Waste

Liquids
Production water and seawater will be re-injected after an initial trial period to investigate the reaction of the reservoir to the mix of sea-and production water. This will greatly reduce the discharge to sea of the produced water. Oil concentrations of the discharged production water will however be according to international protocol and industrial standards. All other fluids will only be discharged if they are rated as 'pose little or no risk' (PLONOR) according to the OSPAR Offshore Chemical Notification Scheme (OCNS) (Category E).

Noise
For the highest noise levels (export tankers) noise sources could take up to a 3 to 5 km radius to decay to a level of 120 dB. A conservative threshold level of 120 dB represents a level at which behavioural responses (such as avoidance) may occur for continuous noise sources by sensitive species. Marine mammals in the general area of drilling and production activities will already be exposed to noise from shipping activity in the area. The main east-west shipping route along the Ghana coast is approximately 8 nm (13.5 km) south of the Jubilee field. Marine mammals occupying or passing through the area will be accustomed to a degree of marine noise from this shipping activity.

Air Emissions
Phase 1 activities, including well completion operations, the subsea equipment and FPSO facility installation, commissioning and operation, export tanker operation, flow line and umbilical installation and support vessel and helicopter operations will emit greenhouse gases and varying amounts of other pollutants such as carbon monoxide (CO), oxides of nitrogen (NOx) and sulphur (SOx), volatile organic compounds (VOCs) and particulate matter (PM). Emissions from the offshore activities are unlikely to have significant direct impacts given the absence of sensitive receptors and the highly dispersive nature of the environment of the offshore location. Operations will comply with MARPOL 73/78 Annex VI standards with regards to air emissions.

Flaring Emissions
Routine flaring will be avoided, however, there will be non routine flaring to maintain safe conditions or during short-duration activities such as start-up, re-start and maintenance activities. A design and operational target will be

established such that abnormal flaring will not exceed 2.5 percent of the monthly average total gas produced. A total of 50,000 scf of hydrocarbon gas is estimated to be purged per day.

Solid Waste
Some wastes generated during the project may be appropriate for disposal offshore, whereas others will be required to be transferred onshore for treatment, recycling, and/or disposal at appropriate facilities. A Waste Management Plan was developed for the drilling phase and this will be updated to include the requirements of the FPSO installation and long term operations. The project will generate both hazardous and non-hazardous wastes and, despite the mitigation measures put in place, given the current limited range and standard of available waste treatment and disposal facilities in Ghana the residual impacts associated with the onshore disposal of waste from the project are of moderate significance. However, assuming all wastes generated by the project are disposed of as planned in the medium to longer term at waste treatment facilities that are designed and operated according to good practice standards then the residual impacts should be limited to ALARP levels. Tullow will upgrade facilities through time to meet these goals. Hazardous wastes that cannot be disposed of locally until facilities are available will be stored ashore at a safe holding site at the Takoradi shore base or exported (in accordance with the relevant conventions) if required.

Impacts from FPSO lighting and flaring
Artificial lighting may disturb and disorientate seabirds feeding or passing through in the area resulting in collisions with the FPSO. However, experience from other offshore installations around the world has indicated that this is not a significant issue and although some collisions may occur, birds would become accustomed to the presence of the FPSO and associated vessels.

These observations are in contrast with observations in the North Sea where migratory birds are disoriented by platform lighting under certain meteorological circumstances, causing massive deaths due to prolonged circling around the platform (Greenlight project NAM and Philips; www.nam.nl; www.philips.nl). In view of the proximity of the East Atlantic Flyway which follows the Ghana coastline, high concentrations of migratory birds during spring and autumn can be expected. It is advised to set up a Monitoring programme with a professional birdwatcher on board to quantify the effects of the lighting onboard the FPSO.

Onshore Bases
The marine support base at Takoradi port will be used throughout the project lifespan for dock space to serve as a loading/offloading point for equipment and machinery. It will also provide quayside facilities for dispatching fuel, chemicals and equipment and allow for temporary storage of spares, production chemicals, fuel and other supplies. Discharges from these activities could impact soil, groundwater and surface water quality but these effects are assessed to be not significant provided that the mitigation measures outlined above are implemented.

Cumulation of Effects
The latter stages of the development well drilling programme will occur in parallel with the Jubilee field Phase 1 well completion programme, facility installation and the early stages of production. The period of physical overlap would be up to 14 months (from arrival of FPSO at site to MODU

demobilisation). There will also be cumulative impacts at the shore locations during this period due to increases in port activity, road transport, air transport and waste disposal. The preferred option takes into account that the planned 17 wells may not be the final total number of wells drilled. 32 slots have been designed and placed on the seabed to cater for an additional 15 wells. Subsequent future drilling in later years will overlap with the production activities at the FPSO.

External activities such as in Saltpond and drilling in neighbouring blocks should be considered as well.

Based on the impact assessment from the Phase 1 Jubilee field activities discussed in the preceding sections, cumulative impacts from other current and future project activities could potentially impact the following resources and receptors:

- habitats and species from physical presence of project infrastructure;
- water and air quality from effluents (including accidental spills) and emissions;
- waste disposal sites from waste arisings; and
- socioeconomic and human impacts from interactions with other users (eg fishermen and shipping) and from employment and procurement.

It is likely that future oil and gas industry developments will increase these impacts and in the longer term, a large scale increase in oil and gas developments in Ghana could lead to cumulative impacts of Major significance at the macro-economic scale. The perceptions of increased employment opportunities and other benefits as a result of the expansion of oil and gas industry activities and associated businesses will be raised and may increase the current rate of in-migration, particularly to Takoradi. Any influx of people could put a strain on facilities and services, such as health and education, currently available to residents.

Strategies that could help to manage potential future cumulative impacts are outlined below.

Strategic Environmental Assessment (SEA). A government led SEA would enable a comprehensive consideration of potential impacts that may result from the development of the oil and gas sector in Ghana.
Build Capacity of Local Administration. The support provided to Regional and District government to build the capacity of its staff would determine the extent to which it is able to plan effectively for future development in the area.
Business Collaboration. Companies operating in the Western Region and the Government of Ghana should collaborate to agree on common standards and approaches for managing cumulative impacts.
Data Gathering and Monitoring. A structured programme of data gathering and monitoring studies would allow for the proactive management of negative trends that could arise over time.
Developing and Enforcing Environmental Management Standards. Environmental standards need to be reviewed and developed for new and existing industries and collectively applied by the government on all businesses operating in Ghana.
National Oil Spill Plan. Collaboration of the oil and gas industry, shipping interests and the Government of Ghana to develop and support an integrated approach to oil spill response including shared resources and expertise and joint training and exercises.

Tullow's suggestion to tackle the cumulative effects via a SEA procedure is sound and should be followed up as soon as possible.

5.14 Mitigation and Management Measures

The mitigation measures will be integrated into the project through the commitments made in the Monitoring Plan and a series of plans and procedures that are outlined in the provisional Environmental Management Plan. Mitigating measures comprise technical improvements on installations, ALARP principles, international codes and guidelines (e.g. MARPOL and IFC), operational procedures, work instructions and internal management plans and strategies.
Development of mitigating measures followed the As Low As Reasonably Practicable (ALARP) levels, taking technical and financial feasibilities into account.

5.15 Monitoring Plan

A detailed environmental and social monitoring plan will be developed for the Jubilee Phase 1 Development project and implemented by Tullow and its contractors. This plan will be modified and updated as the project develops and in response to the outcomes of monitoring activities and in discussion with stakeholders as new issues arise.

Verification by a third party is desirable to assure compliance with such planned modes of operation.

5.16 Decommissioning and Abandonment

At the end of the production life, the project will be decommissioned and abandoned to restore the site to a safe condition that minimises potential residual environmental impact and permits reinstatement of activities such as fishing and unimpeded navigation at the site. The project will dismantle and remove as much of the infrastructure as practicable given the deepwater location. As is typical in deepwater environments, it is likely that the seabed flowlines, manifolds, wellheads (if they cannot be cut off below the seabed) and the suction piles (protruding 1 m maximum above the seabed) will be flushed clean where relevant and then abandoned in place. The approach and techniques for abandonment shall consider industry best practice, which is continuously being developed, as well as prevailing regulations at the time.

5.17 Environmental Management Plan

The present (provisional) EMP will be in accordance with Ghanaian Regulatory Requirements for an EMP which are contained in the Environmental Assessment Regulations of 1999.
The Jubilee Field EMP is a component of the Jubilee Joint Venture's overall Environment Health and Safety Management System (EHSMS), the system the project will use to ensure environmental and social performance. The EMP is intended to cover those activities described in this EIS as well as

linking with the activities covered by the previous drilling EISs. It covers onshore and offshore project activities during drilling, completions, installation, commissioning, operations and decommissioning, and will be subject to thorough reviews prior to the commencement of activities to ensure completeness.

An EMP is correctly regarded as the best tool to develop a system whereby mitigation measures will be integrated with the project and will be taken forward as commitments. Apart from the EMP other key related plans are already in place (i.e. Emergency Response Plan of which the Oil Spill Response Plan forms a part and a Waste Management Plan).
The EMP has applied the What, Where, When and How approach to arrive at the best and/or most suitable alternatives. Training and monitoring are part of the process. There will be a cycle of audits into specific areas of the project such as waste management, and effectiveness of local content plans and discharge controls. The frequency of audits will be risk based and will vary with the stage of the project (more frequent in the early stages of the project) and will depend on the results of previous audits.