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DRAFT ZANZIBAR NATIONAL STANDARD

Environmental protection — Onshore oil and gas exploration and production operations — Requirements

ZANZIBAR BUREAU OF STANDARDS

First Edition

Contents

Foreword

This draft Zanzibar National standard has been developed by Environmental and Risk Management Technical Committee (TCE3). In accordance with ZBS general procedures, this draft standard is presented to the public in order to receive any technical and editorial comment concerns.

Technical Committee Representatives

This Draft Zanzibar National Standard was prepared by Environmental and Risk Management Standards Technical committee which consist of representatives from the following organizations:

Zanzibar Environmental Management Authority (ZEMA)
Department of Environment (DoE)
Tanzania Atomic Energy Commission (TAEC)
Education for Development (E4D)
Zanzibar Upstream Regulatory Authority (ZPRA)
Ministry of Health (MoH)
Directorate of Occupational Safety and Health (DOSH)
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Environmental protection — Onshore oil and gas production operations — Requirements

1 Scope

This Zanzibar National Standard provides requirements for environmentally sound practices for onshore oil and gas production operations and is applicable to all industrial players including contractors, sub-contractors, service providers as well as operators. Facilities within the scope of this standard include all production facilities, including produced water handling facilities. Offshore and arctic areas are beyond the scope of this document. Operational coverage begins with the design and construction of access roads and well locations, and includes reclamation, abandonment, and restoration operations. Gas compression for transmission purposes or production operations, such as gas lift, pressure maintenance, or enhanced oil recovery (EOR) is included.

2 Normative references

The following referenced documents referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ZNS 383, *Solid waste management — Non-hazardous waste*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1

abandoned well

well that is no longer in use, whether dry, inoperable, or no longer productive, having exposed permeable zones, fluids and pressures isolated from surface and from lower pressured zones. An abandoned well may be permanently of temporarily abandoned.

3.2

blowout

uncontrolled flow of reservoir fluids into the wellbore, surrounding rock / soil or to the surface

3.3

contractor

means a second party or an entity to which any interest on the license may be transferred in the application of the provisions of the relevant agreement;

3.4

operator

means a person designated as operator under a joint operating agreement and executed by persons constituting contractor or operating agreement executed by the Corporation and contractor pursuant to relevant agreement;

3.5

injection well

a well in which fluids are injected rather than produced, the primary objective typically being to maintain reservoir pressure

3.6

disposal well
a well, often a depleted oil or gas well, into which waste fluids can be injected for safe disposal. disposal wells typically are subject to regulatory requirements to avoid the contamination of freshwater aquifers.

3.7

gathering line/flow line
in- field pipeline upstream of the processing plant/ modules

3.8

groundwater
subsurface freshwater (potable water) aquifers and any other legally protected/protectable subsurface water resources

3.9

hydraulic fracturing
process of injecting fracturing fluids into the target formation at a force exceeding the parting pressure of the rock thus inducing fractures through which oil or natural gas can flow to the wellbore

3.10

naturally occurring radioactive material (NORM)
low-level radioactive material that naturally exists in native materials

3.11

perforations
holes created between the casing and liner into the reservoir (subsurface hydrocarbon bearing formation). These holes create the mechanism by which fluid can flow from the reservoir to the inside of the casing, through which oil or gas is produced.

3.12

permeability
rock's capacity to transmit a fluid; dependent upon the size and shape of pores and interconnecting pore throats. A rock may have significant porosity (many microscopic pores) but have low permeability if the pores are not interconnected. Permeability may also exist or be enhanced through fractures that connect the pores.

3.13

produced water
any of the many types of water produced from oil and gas wells

3.14

restoration
rehabilitation of a disturbed area to make it acceptable for designated uses. This normally involves re-gardening, replacement of topsoil, re-vegetation, and other work necessary to restore the area.

3.15

reservoir
subsurface hydrocarbon bearing formation

3.16

EOR/IOR

Abbreviation for enhanced oil recovery, an oil recovery enhancement method using sophisticated techniques that alter the original properties of oil
onshore
means all area, terrestrial land and the land covered in the territorial water of Zanzibar

3.17
wetlands
areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions

4 General requirements

4.1 Before drilling or construction, and, in some instances, before modification of onshore oil and gas production facilities, it shall be necessary to obtain approvals from one or more government agencies. In addition to drilling and building permits, permits may be required because of air emissions, discharges to surface waters or sewer systems, injection activities, storm water discharges (including during construction activities), impacts to threatened or endangered species or their critical habitat, impacts to wetlands and other environmental impacts, or impacts to other cultural resources. Operators shall ensure that all necessary permits have been obtained before commencing operations. Operators shall ensure that operations are conducted in accordance with legal and regulatory requirements before production operations commences.

4.2 Specific requirements for surface owners and users, roads, wells and waste handling facilities are given in clause 5, 6, 7, 8 and 9 respectively.

5 Surface owners and users

5.1 The footprint of drilling and production operations for oil and gas projects is variable and dependent upon the operator's equipment, operational needs and the mutual objectives established between the operator and appropriate regulatory agencies. Operators shall be familiar with land use plans, regulations and laws within the country, and (in certain cases) local governments. Different land uses shall require operators to adjust their approaches during site preparation, construction, development or production to avoid or minimize impacts to existing land uses. The development of surface use plans will allow for more efficient use of the land while balancing protection of important local resources, by minimizing surface disturbance and mitigating those impacts that are unavoidable.

5.2 Before drilling or construction on, the operator shall communicate with regulatory agencies concerning activities planned for the site and measures to be taken for safety, protection of the environment, and for minimization of impacts to surface uses.

6 Roads

6.1 General

Roads shall be constructed and used to support various exploration and production (E&P) operations. The environmental impact of the construction of a roadway shall have long lasting effects well beyond the limits of the right-of-way. Existing roads shall be utilized, where feasible, to limit the extent of new road construction, when they meet regulatory requirements, transportation and development needs, and safety and environmental objectives. When building new roadways, they shall be developed in an environmentally acceptable manner consistent with landowner recommendations.

6.2 Planning

6.2.1 Road alignment and right-of-way selection shall be a multidisciplinary process. Goals of the planning effort shall include:

a) affected resource values and safety; and

b) avoidance of haphazard or unnecessary development of roads and associated utility corridors.

The total infrastructure to be developed shall be considered during the selection process. Government agencies, landowners, tenants, and other users shall be consulted during the planning process.

6.2.2 Standards shall be established for the road based on its short-term and long-term function considering geography, traffic density, and load expectations.

6.2.3 Alternative alignments shall be developed considering the following parameters as appropriate:

a) topography;

b) hydrology, drainage, and watercourses, whether intermittent or permanent;

c) engineering properties of soils, erodible soils;

d) location and amounts of excavation and fill materials;

e) type and location of materials for road construction;

f) cultural and historical sites

g) air, water, and noise pollution;

h) wetlands and wetland drainage; consistency with community character and local government needs and plans);

i) proximity to dwellings or other permanent structures occupied or used by the public;

j) visual sensitivity;

k) power lines and pipelines; and

l) other geotechnical factors, particularly in areas of complex terrain, such as landslide areas, sub grade conditions indicating a need for surfacing, potential cut slope problems, and subsurface or surface water problem areas.

6.2.4 Road alignments and potential environmental impacts shall be reviewed. Routes and alignment shall be selected to minimize erosion. Environmentally significant areas shall be identified and avoided to the maximum extent practical, including:

a) sensitive wildlife and critical habitats;

b) areas with endangered, indigenous, endemic and threatened flora and fauna;

c) cultural and historical sites;

d) state, or local areas of concern;

e) areas vulnerable/prone to floods; and

f) wetlands.

6.2.5 When required, mitigation strategies shall be developed in the planning process, including:

a) road operation schedules and/or use of special designs to minimize any adverse impacts in areas with sensitive wildlife and fish habitats, wetlands, existing facilities, crops;

b) plans to take appropriate action on cultural and historic resources before changes are made; and

c) maintenance of existing traffic patterns on highways and local access roads.

6.2.6 Interim reclamation plans and final restoration plans shall be developed and incorporated into the planning process.

6.2.7 Storm water and air (dust) permit requirements shall be considered during the planning phase of the roadway.

6.3 Design and construction

6.3.1 The design and construction of a road shall be site-specific. Each road shall have its own unique terrain, safety, operation, and maintenance requirements. Each area within a route shall support a distinct ecology. When site conditions are appropriate, where suitable for the types of drilling or production operations anticipated, and where compatible with safety and operational concerns, primitive roads shall be considered for use as a means to reduce resource impacts.

6.3.2 Design and construction documents, including plans and drawings, shall be prepared during the planning and design phases before the construction of the project. Plans shall enable proper and timely review of items of environmental concern. They shall also be beneficial for later restoration work.

6.3.3 Construction work shall be scheduled and the use of special designs and local construction practices shall be considered to minimize or avoid undesirable effects on sensitive wildlife and fish habitats, wetlands, and designated reserves, or local recreational areas. Seasonal restrictions such as potential flooding, and wildlife migration shall be considered.

6.3.4 The operator shall confirm that the construction contractor has implemented an environmental and safety program, including the training of construction personnel. This program shall include, where applicable, the following**:**

a) written procedures for a hazard communication program;

b) hazardous material handling;

c) incidence and accidentreporting;

d) emergency response;

e) storm water management;

f) special environmental requirements within the project area; and

g) blasting.

The contractor shall supply material safety datasheets (MSDSs) for all hazardous materials brought on site. Regulatory agencies often require performance bonds when roads are to be constructed in environmentally sensitive areas.

6.3.5 The operator shall hold a pre-construction meeting with the contractor(s) to establish environmental and safety responsibilities along with desired objectives of the project.

6.3.6 Field inspections and lab analysis of soil samples shall be used to assess soil erosion hazards and slope stability. Properties of soils, length and gradient of slopes, and vegetative cover contribute to soil stability. Fitting the profile to topography, locating roads on moderate slopes, providing adequate drainage, and stabilizing slopes decreases surface disturbance and reduces erosion and sedimentation.

6.3.7 Means and methods for erosion control are numerous and often site-specific. Re-vegetation with local species, rip-rap, gabions, woven jute, and energy dissipaters are effective measures that shall be used to reduce erosion.

6.3.8 The use of geotextiles and geosynthetics shall be considered in road planning and construction. These materials offer a variety of applications, aid in stabilizing the road, and minimize the utilization of road bed and surface materials.

6.3.9 An adequate drainage system shall be incorporated into the design and construction of the road. This system shall efficiently intercept, collect, remove, and discharge water from roads. A drainage system that is inadequate or blocked will result in excessive erosion, failures, and higher maintenance costs.

6.3.10 The number of river, stream (including ephemeral streams), lake, and wetland crossings shall be minimized, where possible. Bridges, culverts, and other drainage structures shall be incorporated to ensure the free flow of water when drainage ways are intersected. Different flood stages shall be considered for the design and construction of the crossings.

6.3.11 Clearing widths shall be kept to a minimum. These limits shall be delineated and marked in the field. Sensitive areas or features shall be marked or fenced as required.

6.3.12 Where practical, topsoil should be salvaged and stockpiled in a safe and accessible location and be protected from erosion. The stockpiled material shall be utilized for re-vegetation and reclamation purposes.

6.3.13 Re-vegetation shall be done with local plants, seeds, and grasses species. Means and methods will be dependent upon seasonal considerations, specific project area, and government agency requirements.

6.3.14 Areas of excavation shall be approved before the start of construction. Permits are required for opening pits on federal land and shall be required on other public lands. Pit layout and restoration shall be planned before opening of the pit.

6.3.15 Environmental impacts during coarse/fine borrow material extraction shall be minimized. The following should be considered:

a) use of recycled road surface material from abandoned roads and locations;

b) use of existing mineral material sites;

c) selecting new sites that minimize environmental impacts;

d) developing upland sites to maximize potential for re-vegetation and minimize adverse visual impact and possible erosion; and

e) maintaining a buffer of undisturbed vegetation between borrow pits and highways or other sites.

6.3.16 Warning signs shall be provided to comply with local requirements. The signs shall include among others:

a) road crossings;

b) animal crossings;

c) speed limit;

d) road hazards; and

e) pipelines.

6.3.17 Existing pipelines and other subsurface facilities shall be identified before construction. These facilities shall be protected to prevent accidental damage during the construction and operation of the road.

6.3.18 Measures shall be taken to ensure that proper and adequate procedures for waste disposal and general housekeeping requirements. An effective emergency response plan shall be in place before initiating construction. The plan may simply be a listing of telephone numbers that shall be contacted in case a utility or product line has been damaged. Many times, the existing emergency response plan for the field area shall be adequate and construction personnel shall be familiar with these plans.

6.3.19 Construction activities shall be carried out as described in the construction documents, including plans and specifications.

6.3.20 Construction supervision shall be provided throughout operations. Many potential problems associated with incorrect interpretation of construction documents, spills, waste disposal, poaching, and hunting avoided through proper supervision.

6.4 Primitive or non-constructed roads and routes

6.4.1 Where site conditions are appropriate, and where approved by surface management agency, the establishment and use of "primitive," two-track roads or overland route corridors shall be appropriate for an operator's needs and to facilitate later reclamation of the site. Primitive roads and route corridors shall serve as appropriate access to exploration drilling locations where it is not certain if the well will be productive, or to producing wells where vehicle traffic is infrequent due to the use of off-site production facilities and automated well monitoring. Traffic and load expectations for primitive roads shall be evaluated. If the expectations are exceeded during the project, the road shall be evaluated for upgrades.

6.4.2 The appropriateness of primitive roads and routes is both site-specific and use-specific and is typically based on many factors which shall include the following:

a) anticipated dry or wet soil conditions;

b) seasonal weather conditions;

c) flat terrain;

d) low anticipated traffic; and

e) service company's/driller's/operator's access needs.

6.4.3 Primitive roads or routes shall necessitate low vehicle speeds and shall typically be limited to four-wheel drive or high-clearance vehicles. They shall consist of existing or new roads with minor or moderate grading; two-track roads created by the operator's direct vehicle use with little or no grading; overland routes with a defined travel corridor leaving no defined roadway beyond crushed vegetation; or any combination along the route. Operators shall not flat-blade roads. Drainage shall be maintained, where appropriate, to avoid erosion or the creation of a muddy, braided course of vehicular travel.

6.4.4 Primitive or two-track roads and routes shall be used and established in a safe and environmentally responsible manner and shall not be intended for use as all-weather access roads. Resource damage shall be repaired as soon as possible and the operator shall consult with the surface management agency such as Zanzibar Road Agency to determine if all or a portion of the road needs to be upgraded to an all-weather access road. When used and maintained appropriately, non-constructed roads and routes shall have the advantage of reducing construction, maintenance and reclamation costs and reducing resource impacts.

6.4.5 Approval of a surface resource agency shall generally be required for use of non-constructed roads on other than privately owned lands.

6.5 Maintenance

6.5.1 Proper road maintenance shall be critical for the performance of the road and to prevent and control erosion and sedimentation. Maintenance personnel shall be made aware of environmentally difficult and sensitive areas.

6.5.2 Maintenance work shall be scheduled and the use of special designs and maintenance programs shall be considered to minimize undesirable effects on:

a) sensitive wildlife and coral reefs;

b) wetlands; and

c) state or local recreational areas.

6.5.3 When performing scraping and leveling operations, care shall be exercised to avoid disrupting ditches and shoulders, and creating undesirable berms with the bladed material**.**

6.5.4 Ditches, culverts, and drains shall be regularly cleaned of debris and sediment to allow the free passage of water. Periodic inspections of all culverts shall be conducted. Culverts found to be blocked shall be cleared**.**

6.5.5 Borrow and surface materials shall be readily accessible to be utilized during maintenance operations. Pits opened during construction shall be used as a source for maintenance material, where feasible.

6.5.6 The use of dust control materials or measures shall be evaluated before their utilization. The materials shall not be detrimental to health, vegetation, wildlife, or water quality.

6.5.7 Cutting back weed and hedge growth is essential for road safety. This maintenance operation shall be done with light equipment. Critical review shall occur before use of herbicides or other chemicals is approved for weed control .

6.5.8 There shall be continuous monitoring of drainage and erosion control structures. They shall be maintained and revised, as required, to provide for the intended function.

6.5.9 Erosion shall be prevented and controlled. Areas shall be revegetated, and slopes and soils shall be stabilized.

6.5.10 There shall be an environmental emergency response plan ready to be placed in action during construction and maintenance operations. The plan shall include emergency procedures that shall be followed in the event that the major drainage ways are blocked, fail, or do not perform as required during or immediately after major storm events.

6.6 Reclamation and abandonment

6.6.1 Abandonment procedures shall comply with the legal and regulatory requirements. Consideration shall be given to cost-effective measures that shall minimize environmental impacts. Interim reclamation shall be undertaken for portions of the road or areas disturbed during construction of the road that are not required for vehicle travel. In interim or final reclamation, wherever possible, cut slopes, fill slopes, and borrow ditches shall be re-contoured, covered with topsoil and re-vegetated to restore habitat, forage and scenic resources, and to reduce soil erosion.

6.6.2 Abandonment procedures shall include the following considerations:

a) restoration;

b) abandonment in place;

c) restoration of original or improved drainage;

d) agreement on maintenance requirements, if any, after discontinued use, to be reached between the operator and new user; and

e) agency approval requirements.

6.6.3 Restoration plans shall be prepared in detail and shall consider methods such as:

a) priority of stabilization and re-vegetation of disturbed areas;

b) use of native plant species;

c) stockpiling soils where reclamation would be enhanced; and

d) use of agency approved designs and seed mixes.

7 Exploration, Production, injection and disposal wells

7.1 Completion, stimulation, and work over operations

7.1.1 Planning

For a new well site, an effective planning process shall be carried out and shall incorporate the legal and regulatory requirements for:

a) Emergency preparedness plan

b) waste management;

c) pit location and construction;

d) handling of water discharges; and

e) waste disposal

The location and size of new pits and pads for completion and work over equipment shall be selected so as to minimize disruption of the surface resources and retain the potential for reclamation of the site.

For an existing well site, the planning process shall be important in providing safe and environmentally acceptable completion and work over operations. Existing facilities, such as pits and production equipment, shall be reviewed and assessed to determine whether the facility is suitable in its present condition for the intended well operations or if modifications are required.

For both new and existing well sites, a waste management plan for handling and storing all waste materials generated during completion and work over activities shall be developed.

For information on how to develop such a plan, it shall address the specific wastes which are expected to be produced by the particular operations being performed, as well as providing guidelines concerning the actions that shall be taken in the event that unexpected waste materials, including hazardous materials, are encountered during the operations. In addition to safe handling and storage of waste materials on the well site, provisions shall also be made for each type of waste to be disposed of.

Since much of the work on producing and injection wells is performed by contract or service company personnel, the operating company shall confirm that the contractor's personnel have appropriate safety training, including hazard communication training, and are aware of requirements of the site-specific waste management plan.

Consideration shall also be given to requiring performance bonds, if appropriate.

The operator shall also confirm that the contractor's personnel are aware of all applicable safety and environmental requirements of the operator.

7.1.2 Equipment selection

Temporary equipment required to carry out well completion and work over operations shall be included in the overall operation plan. Equipment shall be installed in a manner so as to utilize the smallest practical area for prudent operations. Equipment shall be maintained to present an acceptable appearance.

7.1.3 Producing wells

Producing wells shall be completed so production zones and drinking waters zones are isolated and shall not be contaminated by other formations. The well shall be cased and cemented properly to provide this protection.

7.1.4 Injection/disposal wells

Injection/disposal wells shall be completed so that injected fluids enter the desired formations and do not enter other formations or drinking water zones. Typical injections are completed with three levels of protection for drinking water formations as follows:

a) surface casing and cement;

b) long string casing and cement; and

c) tubing and packer.

Also, the area around the injection well shall be reviewed to determine whether wells (active, inactive or abandoned) were drilled through the injection/disposal zone.

Wells in drilled zones closer to the injection/disposal shall be protected and isolated from the injection/disposal formation to prevent penetration of fluids that could flow from the injection zone through the improperly plugged or completed well to other oil and gas zones or drinking water zones.

7.1.5 Remedial cementing

For both new and existing wells, the known and anticipated needs for remedial cementing to protect underground sources of drinking water (USDW) shall be considered in the planning stage.

Excess cement, cement returns, and water used to wash cementing equipment shall be contained and disposed of in an environmentally sound manner.

7.1.6 Selection, use, and storage of fuels and completion fluids

Completion fluid selection shall take into account the safety and logistics of transporting, handling, storing, and disposing of clean and contaminated fluid.

For both new and existing well sites, all fuels, treatment chemicals, completion brines, and other similar liquids shall be properly stored in labeled containers intended for that purpose. Containment shall be constructed so that spilled fuels or chemicals do not reach the ground. Wherever practical, tanks or existing drilling pits shall be used for completion and work over operations. Completion brines and other potential pollutants shall be kept in lined pits, steel pits, or storage tanks. If a new earthen pit is necessary, it shall be constructed in a manner that prevents contamination of soils, surface water, and groundwater, both during the construction process and during the life of the pit. Consideration shall be given to the use of tanks or lined pits to protect soil and groundwater contamination especially from brines and oil-based fluids.

Normal operations shall preclude oil in pits, however, in the event that well completion operations dictate use of pits containing oil for a brief period of time, they shall be fenced, screened, netted and/or flagged, as appropriate, to protect livestock, wild game, and fowl.

All liquids and other materials placed in pits shall be recovered, recycled, or disposed in an environmentally acceptable manner (determined by the constituents in the material and the environmental sensitivity of the location).

When operations are completed, pits not required for well operation shall be closed in accordance with the environmental sensitivity of the location. The surface area shall be restored to a condition compatible with the uses of the adjacent land area. Any pit retained shall be of minimum size commensurate with well operations.

7.1.7 Storm water runoff

Natural drainage patterns of the area shall be considered in the location of equipment, pads, and pits so that storm water runoff does not create an environmental hazard by erosion of base material, which could lead to equipment instability, or by flooding of pits, which could cause a discharge of oil or other fluids into the local surface waters.

Discharges of storm water from inside E&P facilities such as bermed areas around tank batteries (including oil and gas exploration, production, processing, or treatment operations or a transmission facility), which can reach waters, shall require a water discharge permit and submittal of a water pollution plan to the Zanzibar

Environmental Management Authority (ZEMA) and other responsible authorities. Contamination includes water that comes into contact with any overburden, raw materials, or waste products on the site.

Construction designs shall include installation of erosion and sedimentation control systems. Site construction shall be inspected routinely and after each significant storm event. Any repairs to the control systems shall be completed promptly. During the drilling and completion phases, all raw materials shall be stored in a manner that prevents contamination of the natural runoff of precipitation. Temporary containment and liners shall be used to minimize the impact of spills and to prevent impacted precipitation from affecting surface or groundwater.

7.1.8 Blowout prevention equipment (BOPE)

All BOPE shall be selected, installed, and properly maintained in order to prevent uncontrolled releases to the environment.

All BOPE shall have a working pressure rating that exceeds the maximum expected surface pressure.

Training exercises or drills shall be held as necessary to ensure crew familiarity and that the BOPE is in good working order.

7.1.9 Control of noise and other nuisances

Engines and production equipment shall be provided with noise abatement measures, if appropriate, to reduce noise levels to the extent practical, considering the local environment. Other nuisances such as odors and dust shall be controlled as considered appropriate for the location. Consideration shall be given to minimizing traffic in general, particularly in or near urban areas.

7.1.10 Solids removal or capture

All produced fluids, drill cuttings; cement, cement returns, NORM scale, and other solids shall be captured and classified, then reused, recycled, or disposed. Hazardous waste shall be segregated in order to prevent contamination of the non-hazardous materials.

7.2 Well operations

7.2.1 Equipment Operation and Maintenance

All well-producing equipment shall be kept neat, clean, painted and in good working order. Equipment shall be painted to blend into the surroundings, if required or appropriate, and kept clean to present an acceptable appearance. Selected moving equipment may be painted with different colors to enhance visibility.

Safety guards necessary to protect humans, livestock, wildlife, and promote public safety shall be maintained around equipment. Equipment lockout/tagout procedures shall also be developed and implemented.

Drip pans shall be provided under equipment and storage containers potentially subject to minor leaks. These drip pans shall be monitored on a routine basis to recover and recycle or dispose of accumulated oil and other liquids.

Bulk storage, recyclable, and reusable containers shall be considered in order to reduce the number of containers that shall be maintained and disposed. All reusable containers shall be well marked to denote contents and the fact that they are to be reused.

The installation or use of double stuffing boxes, leak detectors, and shutdown devices shall be considered in areas of particular environmental sensitivity.

Well cellars shall be kept clean, dry, and guarded to prevent accidental falls. Well cellars shall be filled with sour gas and present a safety hazard to people.

7.2.2 Metallurgy and corrosion

All equipment shall be manufactured from materials which are suitable for the environment in which they are to operate.

Equipment operating in known corrosive conditions shall be inspected on a routine basis for signs of corrosion, with corrective action taken, as needed, to assure the equipment continues to operate in an environmentally acceptable manner. If well production or injection conditions change in terms of hydrogen
sulfide or carbon dioxide content, pressure, water cut, or any other parameter, the metallurgy of the well equipment shall be reassesse to assure its suitability for the new conditions.

7.2.3 Leak detection

All equipment shall be inspected on a routine basis for signs of leakage, with corrective action taken, as needed, to ensure that the equipment continues to operate in a safe and environmentally acceptable manner.

All injection and disposal wells equipped with tubing and packed shall periodically be monitored for tubing casing annulus pressure to test the integrity of the tubing and packer. If a well is not completed with a packer, then other methods shall be used, such as tracer logs or temperature logs to ensure the fluids injected are properly controlled and are going into the proper injection/disposal formation. Frequency of testing is dependent on the operating conditions. For example, if an area has a high number of corrosion failures, testing for the mechanical integrity of the well shall be frequent.

7.2.4 Inspection and certification

Equipment shall be manufactured, refurbished, inspected, and installed according to manufacturer, API or other industry standards, and legal requirements.

7.3 Well testing

7.3.1 Venting and flaring

The company and contractor shall not flare or vent petroleum without require consent from the responsible authority. Where possible, the flare or vent shall be located downwind considering the prevailing wind direction at the well location. Where possible, all gas resources of value shall be captured and used.

7.3.2 Flare pits

Flare pits, sometimes called blow down or emergency pits, shall not be used for storage or disposal. The primary purpose of a flare pit is to catch any incidental fluid that might be associated with the gas stream that does not burn. Fluids in a flare pit shall be removed daily, or as quickly as practical.

Siting and construction of flare pits shall minimize the risk of surface and groundwater contamination. The size of the flare pit shall be proportionate to the volume of liquid effluent that might be expelled from the gas flare. Use of a knockout vessel shall be considered.

7.3.3 Control of noise and other nuisances

Flares may need to be provided with noise abatement measures to maintain noise levels compatible with the local environment. The noise intensity, duration, location relative to public areas and natural resources, as well as the flare/vent exit design shall be considered, where applicable. Other nuisances, such as light emittance from a lighted flare, odors, and dust, shall be controlled as considered appropriate for the location.

7.4 Plugging and abandonment

7.4.1 General

Permanent abandonment shall be done when the wellbore has no further utility and is permanently sealed against fluid migration.

Temporary abandonment operations shall be performed when a wellbore has future utility, such as for EOR projects, and shall be maintained in a condition where routine work over operations shall restore a wellbore to service.

7.4.2 Subsurface

7.4.2.1 General

Environmental concerns related to well abandonment shall be addressed. The primary environmental concerns are protection of freshwater aquifers and underground sources of drinking water, as well as isolation of down-hole formations containing hydrocarbons or used for injection. Additional issues, which shall be evaluated are:

a) protection of surface soils and surface waters;

b) future land use; and

c) permanent documentation of abandoned wellbore locations and conditions.

7.4.2.2 Plugging purpose

The purpose of plugging wells is to prevent interzonal migration of fluids; contamination of freshwater aquifers, surface soils, and surface waters, and to conserve hydrocarbon resources either in the production interval or potential production intervals. Generally, contamination by an improperly plugged and abandoned well can occur in two ways:

a) the abandoned well can act as a conduit for fluid flow between penetrated strata, into USDW, or to the surface; and

b) contaminated water can enter the abandoned wellbore at the surface and migrate into USDW.

Such contamination is prevented when a well is properly plugged. Not only do the plugging operations prevent an abandoned well from becoming a conduit for contamination to occur, but well construction and completion methods also contribute to the prevention of contamination.

Well plugging operations are focused primarily on protecting USDW, isolating downhole formations productive of hydrocarbons or used for injection, and protecting surface soils and surface waters. A surface plug prevents surface water runoff from seeping into the wellbore and migrating into USDW cement plugs isolating hydrocarbon and injection/disposal intervals and a plug at the base of the lowermost USDW accomplish this primary purpose. Surface water entry into an abandoned well is a concern because the water may contain contaminants from agricultural, industrial, or municipal activities. Operators may set a cement plug at the base of the lowermost freshwater aquifer or USDW during plugging and abandonment operations applicable to the well.

NOTE 1: The cement plugs also work to protect surface soils and water from wellbore fluids by confining those fluids in the well.

In addition to the cement plugs described herein, regulatory agencies shall require that cement be plugged across the base of the surface casing and in, or between, each producing and potential producing zone.

7.4.2.3 Fluid confinement

All essential formations bearing usable quality water, oil, gas, or geothermal resources shall be protected and/or isolated. The prevention of gas or fluid migration to other zones or to the surface is of primary importance. Open-hole plugs, casing plugs, or cement squeezed through casing perforations shall isolate the target formations in most cases. However, special procedures, such as perforating casing and circulating cement, shall be necessary to isolate the potential production or injection formations existing behind un-cemented casing Inter-zonal flow in an abandoned well shall be prevented so that such cross-flow does not interfere in the commercial exploitation of the zones through nearby wellbores.

7.4.3 Surface

7.4.3.1 General

The cleanup and remediation of the surface shall include:

a) cutting off the surface casing below ground

b) restoring the surface to conditions near those that existed prior to the well being drilled; and

c) marking the surface of the wellbore by installing an upright marker.

The operator shall restore the well site consistent with the criteria for the Zanzibar Petroleum Regulatory Authority and Zanzibar Environmental Management Authority on solid waste management in exploration and production operations. However, the legal and regulatory requirements shall be consulted before beginning well site remediation.

7.4.3.2 Clean-up and remediation

Assuming the operator opts not to use the well as a freshwater source, the operator shall:

a) set the required surface plugs;
b) remove the wellhead;
c) weld a steel plate on the surface casing stub, if required;
d) fill in the well cellar, rat hole and mouse; and
e) level the area.

Casing strings left in the well shall be cut off three feet to six feet below ground level, or deeper if required by the landowner.

Pits shall be emptied and reclaimed to a condition similar to the rest of the reclaimed pad area. Pits shall be allowed to dry or be solidified in situ before filling. The pit area may be mounded to allow for settling. Before removing or abandoning pipelines or flow lines, fluid displacement and line purging shall be considered and fluid reclaimed, recycled, or properly disposed of according to fluid type.

Open burning may be used in some areas to dispose of non-hazardous, hydrocarbon-containing wastes that are unsuitable for recycling. Burning shall be restricted to materials such as oily sorbents and paraffin and shall be conducted only with approval of local air pollution regulatory agencies such as the Zanzibar Petroleum Authority. Burning shall be conducted during daytime hours and with due regard to wind direction and velocity. The results shall not cause a nuisance that shall result in black smoke or particulates.

Off-site commercial facilities shall be used for other non-hazardous and hazardous waste disposal. The off-site facilities shall be permitted and care shall be taken with site selection in accordance with Oil and gas waste management regulation and other applicable standards in Zanzibar.

7.4.3.3 ***Soil erosion***

Disturbed areas, such as roads, pits, and well sites, may need to be further remediated depending on lease agreements.

7.4.3.4 ***Inspection***

Final abandonment is complete only after all surface equipment is removed, all pits are closed, and the surface is restored. A vertical steel monument shall be considered that indicates the well location, operator, and well number. Thereafter, the abandoned well site can more easily be located and the former operator determined.

8 Operator gathering and system lines

8.1 General

In planning operator gathering and system lines, including electrical distribution systems, it shall be important to consider the impacts that construction operations and maintenance activities have on people, animals, plants, and environment including the land itself, both surface and shallow subsurface. The impacts on current use, as well as possible future uses, shall be evaluated along with potential future facilities expansion. Because pipelines are sometimes buried, and the surface reclaimed, long-term surface disturbance associated with pipelines shall be avoided. The placement of pipelines shall avoid steep hillsides and watercourses where feasible. Also, where feasible, pipeline routes shall take advantage of road corridors to minimize surface disturbance. Also, when clearing is necessary, the width disturbed shall be kept to a minimum and topsoil material shall be stockpiled to the side of the routes where cuts and fills or other disturbances occur during pipeline construction. Retaining topsoil for replacement during reclamation shall significantly accelerate successful re-vegetation.

8.2 Route selection

8.2.1 The following environmental factors shall be considered in planning operator gathering and system lines:

a) proximity to lakes, streams (including dry washes and ephemeral streams), wetlands, drainage and irrigation ditches, canals, flood plains, and shallow water wells. These features shall be evaluated in terms of disturbances during construction and routine operations, and in the event of accidental releases;

b) depth to, and quality of groundwater. The potential impact to groundwater, particularly from any releases from buried lines shall be considered;

c) removal of trees, disturbances to dikes, levees, and terraces, and destruction of growing crops. These impacts shall be evaluated with a focus on construction and routine maintenance activities;

d) impacts to migratory bird habitat or critical habitat of threatened or endangered plant and animal species, including noise and dust;

e) proximity to buildings or other facilities occupied or used by the public. Particular consideration shall be given to homes, churches, schools, and hospitals;

f) impact on arable lands;

g) areas of special historical, archeological, recreational, biological, or scenic significance;

h) land ownership; and

i) location of recently active shallow faults.

8.2.2 The selection of routing for lease gathering and EOR injection and produced water disposal system lines, consistent with production, EOR and disposal requirements and overall economics, shall consider the following:

a) foreseeable uses of surfaces areas by either the landowner or tenant;

b) possible exposure to future construction and excavation work; and

c) topography, when it is an important factor in:

i) line design, right-of-way maintenance, possible land erosion;
ii) emergency response and containment of releases;
iii) location of existing rights-of-way; and
iv) location of existing roads.

8.3 Design

8.3.1 In design of lease gathering and system lines, appropriate industry codes shall be followed.

8.3.2 Lease gathering and system line design shall consider the following:

a) estimated life of the line;

b) line environment (nature of the soil, presence of water-saturated soil, alkaline flats, depth of frost, etc.);

c) nature and quantity of product throughput, initially and as production matures, including the potential for EOR processes;

d) impacts on existing facilities and ;

e) consequences of possible line failure. Release of oil, water, or gas shall be qualitatively evaluated.

Consideration shall be given to installing block valves to isolate line segments located in or near environmentally sensitive areas (such as wetlands), on either side of stream crossings, and in close proximity to areas occupied by the public. Consideration shall also be given to sleeving lines or using heavier walled pipe in these areas. Qualitative evaluation shall consider the following:

i) public impact;

ii) environmental impact (including potential natural resource damage assessment liability);

iii) damage to crops and domesticated animals;

iv) cleanup costs; and

v) political or regulatory impacts.

f) corrosion inhibition measures (external and internal). All equipment shall be manufactured from materials which are suitable for their operating environment;

g) burial to optimum depth to reduce exposure to hazards such as plowing, freezing, and other construction;

h) provisions for various crossings (roads, streams, and other lines);

i) optimum location for blowdown tanks, valves, among others;

j) noise abatement (where appropriate);

k) miscellaneous variable factors including operating pressures, temperature changes, line expansion, and desired safety factors; and

l) if electrical distribution lines are to be installed in areas where raptors are likely to use them as perches, consideration shall be given to installing wooden perch guards or cross members on the poles above the lines to prevent the birds from coming in contact with the charged lines.

8.4 Construction and installation

8.4.1 Lease line routes and applicable rights-of-way shall utilize the smallest practical surface area, consistent with prudent operations.

8.4.2 Unnecessary damage to trees and other vegetation adjoining lease line routes shall be avoided.

8.4.3 If contractors are used to install lines, the operator shall verify that the contractor has implemented a safety program that includes a written hazard communication program. The contractor shall supply MSDSs for all hazardous materials brought on site.

8.4.4 Appropriate inspections shall be performed during construction to ensure design specifications are met.

8.4.5 Upon completion, lines shall be inspected and pressure tested for possible leaks and pressure test fluids shall be collected and disposed in accordance with applicable standards in Zanzibar.

8.4.6 After installation of a new line, all lease line routes and rights-of-way shall be cleaned up and restored to conditions compatible with existing land use, unless other arrangements have been made with the landowner. Disposal of all waste shall be in accordance with the regulations for waste disposal.

8.4.7 Line routes and burial depth shall be adequately documented to aid in preventing ruptures and/or accidental leaks during future excavation activities. Crossings shall be marked as well for ease of visibility during future excavation activities.

8.5 Operation and maintenance

8.5.1 All applicable personnel (both company and contractor) shall receive training to provide for proper operation and maintenance of the lines. This training shall include start-up and shutdown procedures, normal operating procedures, and emergency response procedures, in the event of a leak or spill of a hazardous substance.

8.5.2 Line routes and facilities shall be inspected at intervals dictated by evaluation of exposures and/or failures.

8.5.3 Appropriate steps shall be taken to prevent surface and environmental damage from the use of hot oil, chemicals, and other treatments that are used to maintain lease gathering and system lines.

8.5.4 Proper maintenance practices shall be exercised with respect to crossing markers, blowdown tanks, venting equipment, and corrosion protection equipment. Blowdown fluids shall be collected and placed in the production system to recover hydrocarbons. Waste materials shall be recycled, reclaimed, or disposed.

8.5.5 Pressure tests, profile surveys, and other means shall be considered to meet operating safety requirements.

8.5.6 Operating procedures shall provide for early identification of developing corrosion problems, failure-prone equipment, and malfunctions so that corrective action can be taken before environmental or safety consequences occur. Frequency of failure analysis shall be considered to aid in scheduling line replacements.

8.5.7 Appropriate industry codes shall be followed with respect to maintenance of records, repairs, reporting of leaks, among others.

8.5.8 Whenever modifications are made to existing lines or there are significant changes in physical parameters (temperature, pressure, composition, etc.), the changes shall be considered for evaluation pursuant to management of change principles. Where appropriate, facility drawings shall be updated to show modifications and the superseded drawings destroyed.

8.6 Abandonment of gathering and system lines

8.6.1 All surface lines shall be removed. Lines shall be purged before removal.

8.6.2 Surface and subsurface equipment connected to buried lines shall be removed to a depth consistent with subsequent land use or, preferably, to the depth of the buried lines.

8.6.3 Harmful or hazardous materials shall be displaced from any lines abandoned in place.

8.6.4 Where appropriate, each outlet of abandoned lines shall be permanently sealed.

8.6.5 All crossing markers and other line markers shall be removed.

8.6.6 The location of abandoned lines shall be identified on facility maps.

8.6.7 Upon completion of abandonment activities, all disturbed surface areas shall be cleaned up and restored to conditions similar to the adjacent lands.

8.6.8 Dispose of all waste in accordance to the legal and regulatory requirements.

9 Production and water handling facilities

9.1 Requirement determination (preplanning considerations)

The overall basis for siting, designing, constructing, and operating oil, gas, and water production, handling, and disposal/injection facilities shall be to minimize adverse effects on the environment, consistent with providing an economical means of accumulating well, lease, or unit production from primary, secondary, or tertiary recovery methods and producing the ultimate recoverable reserves. Impacts on local population, land, surface and subsurface waters, air quality, and animal and plant species, including habitat, shall be considered.

Water handling facilities shall typically be located adjacent to, or within, production facilities. Initial planning for these facilities within a field shall consider future development potential in order to minimize surface disturbance. When practical and economic, central field locations shall be considered to avoid the use of multiple facilities. Facility sizing shall consider future throughput increases to minimize the need for additional tankage and treating vessels.

Production and water handling facilities shall be planned to utilize the smallest practical surface area consistent with safe, prudent, and economic operations. In addition, produced water may be saline and corrosive. Therefore, special care shall be taken to minimize the possibility of environmental damage due to equipment upsets, spills, and leaks.

Baseline conditions and past land-use in the area shall be documented. At a minimum, drinking water supplies shall be identified and sampled before any development. Water usage shall be determined during the planning phase so that water rights shall be secured and disposal options evaluated and selected.

9.2 Site selection considerations

9.2.1 Land use

Topographic, population, environmental hazard, zoning, and other maps shall be consulted, where applicable, to locate sensitive or high exposure areas [such as churches, schools, hospitals, residential areas, surface waters, freshwater wells, flood zones, active fault areas, threatened and endangered plants and animals (including habitat), migratory bird habitat, wetlands, archeological, recreational, biological, or scenic areas]. Where feasible, the site shall be located away from these sensitive areas. The potential impact from upset conditions, such as oil or produced water spills and leaks, shall be considered.

Final well patterns shall be considered, if possible, to minimize right-of-way requirements for roads and lease lines. Existing roads and rights-of-way shall be utilized to the maximum extent possible.

The local people/ authorized land users shall be consulted to consider present and future uses of affected and adjacent land/properties.

Production and water handling facilities shall be planned to utilize the smallest practical surface area consistent with safe and prudent operations. Future expansion possibilities shall be considered.

9.2.2 Erosion and drainage

A site shall be selected to minimize the amount of surface terrain alteration to reduce environmental and aesthetic damages. Cuts and fills which pose possible landslide or slump problems shall be avoided. Consideration shall be given to stock piling topsoil, if feasible.

The natural drainage patterns of the land shall be considered in selecting the site. Adequate culverts and drainage ditches shall be provided, as required by the terrain. Soil stabilization, such as sod or grass seeding, shall be provided to prevent erosion. Unnecessary removal of trees or alteration of other natural features shall be avoided.

9.2.3 Water resources

Proper management of water resources during the development and operations phases of oil and gas production shall directly be related to minimizing surface disturbances. Water can be used to create optimal soil moisture conditions to allow for proper compaction of soils, thereby, minimizing surface degradation caused by vehicular traffic and the occurrence of erosion events. Water is also important to help suppress dust and is necessary for drilling, completion and hydraulic fracturing activities. Since a large volume of water is often generated during the oil and gas production process, especially for coalbed natural gas production, additional surface disturbances may result without proper produced water management plans. For example, additional surface water can affect water quality, cause changes to channel morphology in nearby streams, or cause damage to access roads. The release of produced water shall typically be controlled to prevent surface disturbances by utilizing management practices appropriate to the location or circumstances. Depending on the local environment and geology produced water shall be used to support livestock/wildlife watering or for use in irrigation systems if and only if the required standards has been met. Where it is allowed by regulatory authorities, the water shall also be discharged into appropriate water systems or re-injected into suitable reservoirs.

9.2.4 Subsurface soil conditions

Subsurface soil conditions shall be considered for adequate foundation support of buildings, pumps, engines, tankage, and equipment used in the construction process.

Soil characteristics shall be evaluated for construction of dikes, firewalls, and emergency containment areas. Lining of containment areas with compacted clay or synthetic liners shall be considered where porous soil conditions exist or groundwater could be impacted.

Soil corrosiveness or resistivity shall be evaluated to determine whether coating or wrapping of lease lines shall be necessary to prevent or control corrosion. Cathodic protection shall be considered for highly corrosive conditions or sensitive areas.

9.2.5 Fire protection

Production and water handling facilities shall not be located where the equipment will create a potential fire hazard. As applicable, proper fire safety equipment shall be stored nearby.

9.2.6 Public exposure

In noise control planning, production and water handling facilities shall be located as required safety zone established by the ZPRA from the buildings or facilities occupied or used by the public.

Facilities shall be located in such a way that minimizes risk of public exposure from potential hazardous material releases, considering prevailing winds and topographic elevations to the maximum extent practicable.

9.3 Facility design

9.3.1 Equipment sizing, specifications, and design

Consideration shall be given to the following items in designing and constructing production facilities:

a) production-related equipment shall be sized and designed to provide appropriate safety and utility. Future development and exploration plans shall be considered when sizing equipment. Where appropriate, the facilities shall be sized to handle current and future production to minimize retrofitting and improper use of equipment. Equipment shall be designed with appropriate spill control devices, such as high-/low-level indicators or high-/low-pressure indicators, to improve safety and protection of the environment;

b) the anticipated time the equipment is expected to remain active shall be considered. Proper design and installation can minimize future equipment failures and downtime;

c) equipment and foundations shall be designed and installed giving consideration to adverse natural conditions common to the area, such as floods, excessive snow and rain, earthquakes, tornadoes, hurricanes, and dust storms;

d) equipment installations shall comply with industry standards. Air pollution control facilities shall be installed whenever practical, economical, and technically feasible. Flaring vs venting shall be evaluated based on gas volume and composition, safety, economics, and local environmental impact;

e) pressure requirements for vessels, lines, and other equipment shall be considered. Any variance from the manufacturer's recommended rates or pressures shall be evaluated thoroughly.

f) installing fired lease vessels and the following items shall be considered:

i) surrounding facilities when selecting the placement of fired lease vessels;

ii) manufacturer's recommendations shall be followed. Any variances from these recommendations shall be evaluated thoroughly;

iii) fired lease vessels shall not be located immediately adjacent to oil, gas, or any other flammable or explosive storage facilities. Facilities shall have a grade established so that releases of flammable fluid drain away from fired equipment;

NOTE 1: Some states have minimum distance requirements between fired vessels and storage facilities.

iv) vessels shall be well maintained and free of unnecessary debris or flammable products;

v) fencing or some form of guarding shall be considered to protect the public, livestock, and wildlife; and

vi) air permitting requirements for fired lease vessels.

g) installing bulk storage and loading facilities and the following items shall be considered:

i) adequate fire/retaining walls or other containment measures shall be provided around tanks, where necessary to comply with regulatory requirements, in order to contain accidental discharges and prevent environmental damage. No open pipes shall extend from within the firewalls which might allow contaminated fluids to be drained or siphoned from inside the containment area;

ii) Installation of impervious foundations or liners under storage tanks shall be considered to allow detection and containment of fluid releases;

iii) installation of high-level alarms and/or monitors shall be considered on tankage;

iv) installation of drip pans or other containment shall be considered at truck or barge loading/unloading hose connections to contain any spillage; and

v) emission permits shall be obtained based on the highest anticipated production rates and equipment specifications before installation of the facilities or commingling well production to central facilities.

h) installing internal combustion (IC) engines and compressor facilities and the following items shall be considered:

i) minimizing noise disturbance. IC engines and compressor facilities shall be located as far as practical from areas accessible to the general population. If feasible, alternate types of prime movers, such as electric motors, shall be considered;

ii) emissions generated by the engine(s) exhaust shall be of concern. Appropriate lead-time for permitting shall be allowed, as it may require from six months to one year to permit compressor facilities. All required construction and emissions permits shall be obtained before construction, modification, or relocation of an engine is initiated. The type of fuel shall be selected to minimize pollutants. Electric power shall be considered, where feasible;

iii) drip pans or placing engines and compressors shall be installed on impervious pads to minimize the impact of potential oil and chemical drips and spills. If drip pans or impervious pads are used, special attention shall be given to ensuring that they are kept clean and that any oil or chemical collected is removed, recovered, and recycled or disposed in a timely and proper manner;

iv) piping for the relief valves of compressors shall be of adequate size and piped to an appropriate vent or flare; and

v) placing fences, guard walls, or buildings around all engines and compressors shall be considered for the protection of the public and any livestock or wildlife.

i) planning, installing, and using pits, firewalls, and dikes and the following items shall be considered:

i) tanks shall be used instead of pits whenever practical;

ii) existing pits shall be minimized and alternate means considered, where feasible. Pits shall only be used for the purpose they were intended. Personnel shall be advised on the specific use of the pit and what substances shall allowed therein;

iii) necessary precautions shall be taken to protect ground and surface water, crops, trees, livestock, and wildlife during the design and construction of pits and firewalls;

iv) pits shall be designed and constructed to have sufficient freeboard, or provide adequate reserve capacity and prevent overflow under maximum anticipated operating requirements and precipitation;

v) pits shall be fenced or otherwise equipped, as necessary, for public safety and to protect livestock and wildlife;

vi) netting of pits shall be done to protect migratory birds from exposure to the pit contents if there is a potential for the pit to have an oily surface or to contain potentially harmful substances;

vii) burn pits shall be located where prevailing winds will reduce fire hazards and smoke nuisance;

viii) storage vessels for liquid hydrocarbons, saltwater, chemicals, or other fluids that are not acceptable to be discharged into the local environment shall have dikes constructed around their perimeters

ix) dikes and firewalls shall be constructed of material to prevent the release of fluids to the local environment during an accidental or emergency discharge from their original containment; and

x) dikes and firewalls design shall have a sufficient perimeter and wall height to contain the maximum volume of the largest vessel or tank contained within, and with sufficient freeboard for maximum rainfall and snow melt. Any drain lines through dikes shall be equipped with valves/blinds that are normally closed and locked.

j) use of utilities at production sites shall be considered and the following items shall be taken:

i) existing utilities shall be considered in the design of production and water handling facilities;

ii) if electricity is available, the use of electric motors/prime movers shall be considered to minimize air emissions and noise;

iii) storage facilities shall not be located under or near major electrical transmission lines; and

iv) all electricity, potable water, sewage, and municipal gas lines shall be installed in accordance with any applicable codes or regulations.

k) designing and installing flares/vents at production sites and the following items shall be considered:

i) flares/vents utilized in production facilities shall be located downwind (with respect to prevailing wind direction) from the installation and at a proper safe distance from the related equipment;

ii) surrounding environment shall be considered when designing flares. The flare shall be located far enough from trees and other vegetation to ensure that they shall not be ignited during times of maximum flare and strong winds. Installation of liquid scrubbers shall be considered;

iii) flares and vents, assuming vent ignition, shall be of sufficient height to protect workers and the public during maximum flaring/venting and strong winds;

iv) fencing around flares shall be considered to protect the public, livestock, and wildlife;

v) installation of automatic igniters, rather than standing pilots, shall be considered, where feasible, to conserve natural gas and reduce emissions;

vi) flares shall be of a smokeless design, if possible; and

vii) consideration shall be given to design features which shall prevent raptors or other birds from perching on flares.

l) safety systems for protecting the environment shall be considered as follows:

i) installation of safety equipment and systems shall be considered, i.e. emergency shutdown (ESD) systems which have the ability to shut wells in, shut down compressors or other engines, or divert production during malfunctions or accidental releases. Where appropriate, alarm systems shall be installed to notify the public or company officials of equipment failure or accidental releases. Equipment for fire protection shall be installed and maintained, such as, fire extinguishers, spray nozzles, fire pumps, water storage, and automatic extinguishers.

m) corrosion abatement procedures shall be considered as follows; and

i) corrosiveness of the anticipated gas or fluid shall be considered during the design and selection of the equipment;

ii) where corrosion problems are anticipated, a corrosion abatement program shall be established to minimize the potential for leaks; and

iii) soil corrosiveness or resistivity shall be evaluated for necessity of coating or wrapping of lines to be buried. In some cases, cathodic protection may be necessary.

n) reducing air emissions associated with production and water handling facilities shall be given a special consideration. The following items shall be considered during design and construction of these facilities:

i) vapor recovery units and flares;

ii) catalytic converters on fired equipment exhaust;

iii) minimization of benzene, hydrogen sulfide, and other hazardous emissions from tanks, glycol re-boilers, and other equipment;

iv) minimization of operational gas vents, leaks, and discharges from pneumatic controls and other equipment;

v) electric powered prime movers; and

vi) valves installed on dead end piping shall be capped, plugged, or sealed by a blind flange.

9.3.2 Equipment location

9.3.2.1 Production and water handling facilities shall be located where they do not present a fire hazard to nearby facilities. Fired vessels, IC engines, flares, or other equipment that produce sparks or flames shall be appropriately separated from oil and gas storage facilities. Topographic and other maps shall be consulted to determine if operational problems shall affect the local environment. This shall include, but is not limited to the possibilities of oil or water discharges draining into surface or ground waters. Minimization of damage to vegetation crops, forests, animal habitation, among others shall be considered. Unnecessary removal of trees, excessive grading, or alteration of other natural features shall be avoided.

9.3.2.2 In populated areas, the location of equipment shall take advantage of prevailing winds in order to ensure public safety in the event of equipment malfunction, release, or fire. In all cases, production and water handling facilities shall be located as far as practical from buildings occupied or used by the public.

9.3.2.3 Noise levels of production and water handling facilities shall be considered when operating near populated areas.

9.3.2.4 Equipment shall be located with consideration given to subsurface soil conditions such that there is an adequate foundation to support the facilities to be constructed and the equipment to be used in the construction processes.

9.3.2.5 The location of all wells shall be considered to minimize rights-of-way requirements for roads and gathering lines.

9.3.3 Waste management

9.3.3.1 Equipment and facilities shall be located and designed to minimize the wastes generated by operations and maintenance activities.

9.3.3.2 Recyclable products shall be used, where possible. Bulk storage, recyclable, and reusable containers shall be considered to minimize waste generation.

9.3.3.3 Appropriate methods of collecting and recycling or disposing of waste generated during construction, operation, and maintenance of the facility shall be considered.

9.3.3.4 Operators shall develop waste management plans in accordance with environmental regulations and other relevant standards applicable in Zanzibar.

9.4 Construction considerations

9.4.1 Site preparation

The following site preparation steps shall be taken before initiating construction:

a) soil characteristics shall be checked to determine the appropriate foundation design for the site;

b) size and type of equipment to be used during construction shall be considered to allow sufficient room to work in a safe manner;

c) adequate culverts and drainage ditches shall be provided as required by the local environment; and

d) the open end of lines under construction shall be temporarily capped at the end of each workday if a line is accessible to wildlife.

9.4.2 Inspection and testing

The following inspection and testing steps shall be taken before initiating construction:

a) during construction, qualified personnel shall perform appropriate inspections to ensure that design specifications are met;

b) upon completion, equipment and facilities shall be inspected for possible leaks. If necessary, equipment shall be pressure tested in accordance with applicable codes. If fluids are used to pressure test, they shall be collected and disposed of; in accordance with applicable standards in Zanzibar; and

c) X-raying of welds shall be considered in critical areas where extreme pressure or corrosiveness is anticipated or where potential risk to the local environment is of great concern.

9.4.3 Qualification of personnel

The qualifications of personnel working on the construction site shall be evaluated to aid in ensuring that the work shall properly be performed.

9.4.4 Selection of contractors

Consideration shall be given to requiring contractors to have performance bonds should be considered when facilities are to be constructed in environmentally sensitive areas.

9.4.5 Equipment installation

All equipment shall be installed in accordance with the original design of the equipment. Any variations from the original specifications shall be evaluated thoroughly to ensure safety of the operations.

9.4.6 As-built drawings

Upon completion of facilities, the original drawings or schematics shall be updated, as required. Changes or modifications from the original design or drawings shall be noted for future reference.

9.4.7 Site clean-up

Unused and excess construction materials shall be properly stored or removed from the site upon completion. During construction, the site shall be kept as clean and free of debris as possible. Where feasible, unused material shall be removed from the construction site as it is determined to be surplus. Where applicable, construction waste shall be recycled in accordance with ZNS 383.

9.4.8 Interim reclamation

Interim reclamation shall consist of minimizing the footprint of disturbance by reclaiming to the extent possible that all portions of the site are not required for production operations. The portions of the cleared site not needed for operational and safety purposes shall be re-contoured to a final or intermediate contour that blends with the surrounding topography as much as possible. Sufficient level area shall remain for the set-up of work over or production stimulation and to park necessary equipment. Where practical, the operator shall spread topsoil over the entire location and re-vegetate as closely as possible to the production facilities unless an all-

weather, surfaced access route or turnaround is needed to inspect or operate the well or to complete work over or stimulation operations.

It may be necessary to drive, park and operate on restored, interim vegetation within the previously disturbed area provided damage is repaired and reclaimed following use:

a) to reduce final reclamation costs and effort;

b) to maintain healthy, biologically active topsoil; and

c) to minimize habitat, visual resource, and forage loss during the life of a well-salvaged topsoil shall be spread over the areas of interim reclamation rather than stockpiled.

Where the topography is flat and it is therefore unnecessary to re-contour the well location at the time of final reclamation, the operator shall set aside sufficient topsoil for reclamation of the small unreclaimed area around the wellhead. Any topsoil pile set aside shall be revegetated to prevent it from eroding and to help maintain its biological viability. On sloped ground, during final reclamation the topsoil and interim vegetation shall be restriped from portions of the site that are not at the original contour, the well pad recontoured, and the topsoil respread over the entire disturbed site to ensure successful revegetation.

9.5 Operation and maintenance

9.5.1 Operational procedures

9.5.1.1 Development of a Standard Operating Procedure (SOP) manual applicable to each major facility shall be considered. The SOP shall contain information as to the equipment located at the facility, safe-operating practices for the equipment, start-up and shutdown procedures, and emergency procedures.

9.5.1.2 Analysis of failures or malfunctions shall be done so that corrective action can be taken to minimize future environmental incidents.

9.5.2 Personnel training

Personnel shall be trained in the safe and efficient use of facility equipment.

9.5.3 Equipment inspection

Routine inspections shall be carried out on all equipment operating in corrosive environments. All safety equipment shall be tested on a routine basis to ensure proper operation.

9.5.4 Corrosion monitoring and treatment

Corrossiveness of the produced fluids shall be Regularly monitored and corrosion abatement program shall be carried out. This is especially important in populated or environmentally sensitive areas. Operating procedures shall provide for early identification of potential corrosion problems in failure-prone equipment.

9.5.5 Housekeeping

9.5.5.1 The facilities shall be kept clean, maintained, and operated in a safe and environmentally sound manner.

9.5.5.2 Facilities shall be fenced in a manner to prevent access to the facility by the general public, livestock, or wildlife, where appropriate.

9.5.5.3 Signs shall be posted in conspicuous locations to notify employees and the public of any dangerous situations such as, flammable conditions, high voltage, and hydrogen sulfide.

NOTE 1: State or local regulations may specify certain posting requirements.

9.5.5.4 Emergency phone numbers shall be posted at the entrance to the facility, if located near a populated area.

9.5.5.5 Weeds shall be controlled to a degree compatible with the local environment by cutting, mowing, or spraying to improve appearance and reduce the fire hazard. When herbicides are used to control weeds, the chemicals shall be properly applied by trained personnel.

9.5.5.6 All equipment shall be painted and/or kept clean to present an acceptable appearance and to provide protection from external corrosion.

9.5.5.7 Waste receptacles shall be provided at appropriate locations for collecting discarded paper, rag and any other waste and emptied on a regular basis.

9.6 Waste and residual management

9.6.1 General

Waste and residual management practices for production operations shall be conducted consistent with lease and landowner obligations. This shall include:

a) solid wastes and residuals such as:

   i) tank bottoms; and

   ii) drilling fluids and cuttings.

b) liquid wastes and residuals, such as: and

   i) produced water; and

   ii) used oil.

c) gaseous wastes, such as:

   i) hydrocarbons; and

   ii) carbon dioxide.

NOTE 1: A sound waste management plan is important to protect human health and the environment and minimize long-term liabilities to the operator.

A waste or residual management plan shall utilize one or all of the options listed in 9.6.2 to 9.6.5 in order of preference, to protect human health and the environment:

9.6.2 Source reduction

Source reduction involves decreasing the volume or toxicity of wastes or other residuals that are generated. Product substitution is an example of source reduction. Production and workover chemicals shall be evaluated to determine if less toxic substitutes are available that meet the performance and economic criteria of the operator.

Reviewing common-sense housekeeping practices can be effective in reducing waste or other residual generation. Installing drip pans, as an example, on valves and fittings allows the collection of leaked oil before it contacts the soil and becomes a waste.

9.6.3 Recycling and reclaiming

After all reduction options are considered, recycling or reclaiming the residual material shall be evaluated. Examples of recycling and reclaiming are recovering waste oil, hydraulic oil, and oily sump water by reintroduction into the oil stream or transportation to a refinery. Drums, batteries, and scrap metal can be sold or returned to the vendor, where possible. Tank bottoms and sludges can be sold to reclaimers, where feasible.

9.6.4 Treatment

Following reduction and recycling efforts, treatment of waste shall be considered to minimize the waste volume and the toxicity of the waste. Filtration, centrifugation, evaporation, and flocculation are examples of reduction techniques that reduce the volume of the actual waste that must be disposed. The toxicity of certain wastes can be reduced by chemical treatment, thermal treatment, and biodegradation before disposal.

9.6.5 Disposal

The final option for management of a waste, after source reduction, recycling, and treatment options have been considered and incorporated, is disposal. The operator shall take into consideration the long-term fate of the waste and its constituents before disposal. Considerations that shall be evaluated when choosing either an on-site or an off-site commercial disposal method are as follows:

a) general site review of the topographical and geologic features;

b) groundwater review to determine the presence of groundwater and aquifers;

c) area weather patterns to estimate rainfall and flooding potential;

d) general soil conditions;

e) natural drainage areas;

f) identification of environmentally sensitive conditions; and

g) air quality.

These criteria will help determine a waste disposal option that protects human health and the environment and limits future liability for the operator. Examples of waste disposal options that shall be considered are:

a) land spreading;

b) road spreading;

c) on-site burial;

d) on-site pits;

e) annular injection;

f) underground injection wells;

g) regulated and permitted discharge of fluid;

h) incineration; and

i) off-site commercial facility.

The operator shall maintain adequate documentation of waste management activities. Development of a long-term records retention policy shall be considered in accordance with zns 383.

9.7 Spill prevention, response, and clean-up

9.7.1 General

Accidental spills (including oil and saltwater) can, besides potentially damaging the environment, create difficult operational, legal, and public relations problems. It is very important to conduct operations in a manner that minimizes the potential for unauthorized spills. Spill prevention, response, and clean-up procedures shall be defined and in place before storing any oil or chemicals on site or conducting activities that have a potential for a spill. The operator shall implement operating practices to minimize waste volumes and impacts on the environment.

9.7.2 Prevention

The best way to avoid adverse effects of spills is to prevent their occurrence. The key factors in spill incident prevention are adequately trained supervisors and field operating personnel. The following basic steps shall be taken to prevent accidental spills.

a) the facility design shall be reviewed to determine where the potential for spills exists. Information on prior spill incidents should be included in the review to assess areas where changes in equipment or practices may be needed. Using the results of the review, the following shall be considered, as appropriate:

i) modification of existing facilities or installation of new equipment or instrumentation, as needed, to reduce the possibility of spills, commensurate with the risk involved. Consideration should be given to the use of alarms, automatic shutdown equipment, or fail-safe equipment to prevent, control, or minimize potential spills resulting from equipment failure or human error;

ii) maintenance and/or corrosion abatement programs to provide for continued adequacy of all equipment;

iii) routinely scheduled tests and inspections of lines, vessels, dump valves, hoses, and other pollution prevention equipment where failure(s) and/or malfunction(s) could result in a potential spill incident. These tests and inspections shall be commensurate with the complexity, conditions, and circumstances of the facility;

iv) operating procedures that minimize potential spills. These operating procedures shall be clearly written and available to all operating personnel; and

v) examination of field drainage patterns and construction of oil traps in drainage ditches at strategic points to contain spilled oil before it reaches streams or water basins.

b) training programs shall be developed on spill prevention fundamentals and presented to operating personnel as often as necessary to keep them well versed on spill prevention practices; and

c) contingency and shutdown plans shall be developed for coping with hurricanes and other disasters (both natural and manmade) so as to minimize the potential for oil spills or incidents causing pollution or other environmental damage.

9.7.3 Mitigation

Some other associated steps that shall be taken to reduce the potential for oil spills are:

a) “dead” piping and temporary connections shall be removed when they are no longer required;

b) piping subject to vibration shall be braced to reduce movement and resulting fatigue failures;

c) tanks shall be checked for uneven settlement of the foundation, corrosion, and leaks;

d) pressure relief valves shall be installed for liquid lines, which, if left full, could potentially rupture from liquid expansion due to heat; and

e) sleeve-type line couplings shall not be used when there is a chance of line movement.

9.7.4 Spill contingency plan

In the event a spill occurs, it is extremely important for all responsible operating personnel to know how to respond quickly and effectively to control, contain, and clean up the spill. To ensure this capacity exists, a contingency plan shall be prepared for inland areas as well as for areas near water. The plan shall provide utilization of capabilities of oil spill co-operatives, whenever advantageous.

The spill plan shall address the needs to advise the public about significant releases. The plan shall include procedures to advise government officials and provide appropriate information and access to the press.

9.7.5 Control and containment

In the event a spill occurs, the source of the spill shall be stopped, or reduced as much as possible, in a safe manner. The spread of the spilled substance shall be controlled or contained in the smallest possible area to minimize the adverse effects. Some methods which can be used to control and contain discharged substances, particularly oil, include:

a) retaining walls or dikes around tanks and other spill prone equipment;

b) secondary catchment basins designed to prevent the spread of oil if it escapes the primary wall or dike;

c) permanent booms in water basins adjoining the facility;

d) temporary booms deployed in the water after the spill occurs; and

e) use of special chemicals to jell or biodegrade the oil to prevent the spread of oil spilled into or on water.

Operators shall evaluate the potential for spills and damages and use this information to determine the type and size of primary and secondary containment necessary.

The type and footage of containment boom installed or stored for deployment shall vary with the type, size, and location of the facility and spill potential. This information shall be developed for each main area or facility and be stated in the facility contingency plan. In addition, the contingency plan shall list where emergency equipment is located.

The contingency plan shall state the type(s) of chemicals that shall be used effectively and list sources and procedures for applying these chemicals. Spill response drills/simulations shall be considered, with regulatory agency and contractor personnel participating.

9.7.6 Clean-up

Clean-up procedures shall be developed and included in the facility contingency plan. Up-to-date lists of effective clean-up materials and equipment and a list of potential contractors who can supply needed assistance shall also be included and maintained in the contingency plan.

Depending on the spill potential at each area, a stock of appropriate cleanup materials sufficient to handle small spills shall be maintained on hand at all times. The amount of cleanup material will depend on the time required to obtain more material if the size of the spill should increase.

The following suggested clean-up practices should be considered:

a) using clean-up materials and equipment on hand, immediate action should be taken to clean up any spilled oil or other substance. Depending on the substance spilled, personnel performing and supervising clean-up operations may require specific training;

b) advance planning and arrangements should include availability and ready access to vacuum trucks and to similar pickup equipment to recover the spilled material;

c) necessary approvals should be obtained before disposal of spill clean-up materials;

d) advance arrangements should be made for rights of ingress and egress to public and private property that may be affected by a spill or the ensuing clean-up operation;

e) land owners should also be notified of spills and kept informed of spill clean-up progress; and

f) plans, procedures, and programs should be improved and updated by analysing previous spill incidents.

Prevention, control and containment, and clean-up procedures shall be revised accordingly to make them more effective for future responses.

9.8 Environmental assessment before purchase or sale of existing fields and leases

Before the purchase or sale of an existing field, consideration shall be given to documenting the environmental condition of the groundwater contamination. An operating company shall be required to reduce its exposure to significant future liabilities.

Documentation of audits, assessments, and operating practices is important to identify potential problem areas. Care shall be taken to document actions taken to correct deficiencies identified by audits.

9.9 Closure and abandonment of facilities

9.9.1 Purging and flushing of equipment before removal

All equipment such as tankage, separation vessels, meter runs, flow lines, and pumps shall be purged and/or flushed, as appropriate. Whenever possible, materials recovered shall be recycled, reclaimed, or disposed in accordance with ZNS 383.

9.9.2 Equipment removal

The following equipment removal issues shall be considered:

a) tanks, separation vessels, meter runs, surface lines, pumps, and any other exposed surface equipment shall be removed. Removal of the associated equipment foundations shall be considered;

b) exposed piping segments from surface or subsurface equipment connecting to buried lines shall be removed to a depth consistent with subsequent land use or, preferably, to the depth of buried lines. where feasible or where desired to limit potential future liabilities, consideration shall be given to removing buried lines;

c) where appropriate, each outlet of any abandoned lines shall be permanently sealed.

d) operators shall consider removing all crossing markers and other line markers; and

e) where appropriate, the location of abandoned lines shall be identified on facility maps.

9.9.3 Pit Closure

All pits and surface impoundments shall be properly closed after they are dry and free of waste; then they shall be backfilled and graded to conform to the surrounding terrain. Closure must also be in accordance with any local and/or state regulations. The location of closed pits shall be documented. Materials removed from pits shall be reclaimed, recycled or disposed in accordance with Oil and gas waste management regulation and other applicable standards in Zanzibar.

9.9.4 Land reclamation and restoration

Upon completion of abandonment activities, all disturbed surface areas shall be cleaned up and restored to conditions similar to the adjacent land. Documenting the presence or absence of surface, subsurface, or timely completion of final reclamation shall be important during the initial planning. Incomplete or improperly executed final reclamation can result in the complete loss of a low-impact project opportunity. Reclamation shall be significantly more difficult, more expensive, and less effective if sufficient topsoil is not salvaged, if interim reclamation is not completed, and if proper care is not taken to construct pads and roads in locations that minimize reclamation costs.

Revegetation shall not constitute successful reclamation, but restoration of the original landform as a key element in ensuring that the effects of oil and gas development are not permanent.

To achieve final reclamation of a recently drilled dry hole, the well site shall be recontoured to original contour or to a contour that blends with the surrounding landform, stockpiled topsoil redistributed, and the site revegetated. To achieve final reclamation of a formerly producing well, all topsoil and vegetation shall be restriped from all portions of the old well site that were not previously reshaped to blend with the contour of the surrounding landform. All disturbed areas shall be recontoured back to the original contour or a contour that blends with the surrounding landform, topsoil is redistributed, and the site re-vegetated, using native plant species or agency approved seed mixes that are acceptable to the landowner or trustee.

In re-contouring areas that have been surfaced with gravel or similar materials, the material shall be removed from the well location or buried deep in the re-contoured cut to prevent possible surface exposure.

Infrastructure, including water impoundments, power lines, metering buildings, compression facilities and tank batteries shall be removed and the footprints or lands disturbed by these facilities and associated foundations reclaimed unless the surface owner requests that items such as impoundments or water wells be kept.

Salvaged topsoil shall be re-spread evenly over the surfaces to be re-vegetated. The top-soiled site shall be prepared to provide a seedbed for re-establishment of desirable vegetation. Site preparation may include gouging, scarifying, dozer track-walking, mulching, fertilizing, seeding and planting. In reclamation of sites that are not cultivated for agriculture or grazing, seeding and planting shall use plant species indigenous to the area.

Water breaks and terracing shall only be installed when absolutely necessary to prevent erosion of fill material and shall be removed when the site is successfully re-vegetated and stabilized.

Annex A

(informative)

Good neighbour guidelines

A.1 General

The oil and natural gas industry is dedicated to responsible development of oil and natural gas resources. Responsible development includes good relationships with our neighbors and a commitment to environmental protection and compliance with all applicable state and local regulations.

To be a "good neighbor" in the areas where industry operates, we have three objectives:

a) protection of public safety;

b) protection of the environment; and

c) respect for the property rights of others.

These objectives are achieved through use of sound management processes as part of the responsibility to act as a "good neighbor." As our industry pursues responsible development of energy resources to meet the nation's energy needs, we should strive for better communication and understanding with the land owners, leasees, permittees and/or residents ("land owner or surface users") impacted by our operations.

A.2 Good neighbor practices

A.2.1 Listen to the land owner or surface user concerns and respond appropriately:

a) respect rights-of-way;

b) take precautions to protect livestock;

c) take precautions not to harm wildlife with our operations;

d) drive safely;

e) report damages to public or private property to the appropriate parties;

f) maintain production equipment and systems; and

g) train personnel on the rules and regulations applicable to our operations.

A.2.2 Communicate with land owners and surface users:

a) be willing to discuss with the land owner or surface user of industry property user rights (including mineral rights) and surface user rights;

b) designate a company contact person who is responsible for responding to community questions;

c) listen to and discuss the concerns of the land owner or surface user affected by our operations; and

d) attempt to notify the landowner or surface user when commencing significant activity that will impact their land.

A.2.3 Respect the property and the rights of others:

a) minimize surface disturbances;

b) take precautions to protect livestock with appropriate measures;

c) practice good housekeeping;

d) remediate and restore the site in a timely manner in compliance with applicable regulations; and

e) drive responsibly on public and private roads.

A.2.4 Promote safety of the general public:

a) train personnel in safe operating practices;

b) conduct emergency planning where applicable; and

c) post signage and warnings in accordance with regulations.

A.2.5 Protect the environment:

a) train personnel on environmental protection in compliance with applicable regulations;

b) maintain equipment and utilize good work practices;

c) seek to understand the land owner, and surface user concerns and possible questions regarding; and

i. groundwater aquifers and surface water,

ii. air quality,

iii. wildlife and livestock protection,

iv. housekeeping,

v. noise,

vi. surface disturbance; and

vii. noxious weeds and brush;

d) follow regulations for waste management and environmental protection.

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