AZERBAIJAN BUSINESS UNIT (AzBU)

Procedure for: Water Quality Management

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1 Introduction

Document Purpose

This Safe System of Work outlines the:

- standards required for domestic and potable water quality
- the actions required on non-conformance with set regulatory compliance
- recommendations to minimise risk of potable water system contamination.

Document Scope

This Safe System of Work applies to all BP owned or managed offices, sites and offshore installations in Azerbaijan and Georgia, including remote locations where water is extracted from wells or tankered to site.
The guidance provided in this Safe System of Work is based on more detailed information available from sources such as the United Kingdom Offshore Operators Association and the World Health Organisation. This document does not replace such guidance but presents it in summary form as an example of best practice.

Definitions

For the purpose of this document, the following definitions shall apply:

Domestic water: The water supplies used for bathrooms, machine dishwashing, clothes laundering, etc. Domestic water may only be used for hand dishwashing provided it has been boiled or the final rinse is done with potable water

Potable water: Any water intended for drinking, the preparation of food and teeth cleaning.

Note: The piped water supplies at most BP sites along its pipeline routes is of domestic water quality only.

1.4 References

- World Health Organisation International Standards - *Guidelines for Drinking Water*, 3rd Edition 1971
- *Guidelines for Environmental Health for Offshore Installations* (UKOOA), January 1996 (under revision)
- *The Prevention or Control of Legionellosis (including legionaries disease),* ACoP 1995
- *The Control of Legionellosis including Legionnaires Disease* HS(G)70, 1993 (under revision)
- *The Control of Legionellosis in Hot and Cold Water Systems*, HSE MISC150, 1998
- BP Group Recommended Practice and Specification for Engineering RP 60-5, *Potable Water Systems*, July 1992.

2 Roles and Responsibilities

Site Manager / Offshore Installation Manager

Site Managers shall be responsible for ensuring that:

- adequate provisions are made for the supply of domestic and potable waters that are clean and wholesome
- a suitable and sufficient assessment has been carried out with regard to the risk from legionellosis
- domestic water supplies are clearly labelled as not suitable for drinking
- an adequate supply of bottled potable water to sites where the site fixed supply is of domestic quality only.

In addition, Site Managers are responsible for notifying Health and Safety (Occupational Health Department) of domestic and potable water sources and storage facilities (capacity, material, etc.), extraction and treatment methods.

Procurement

Those responsible for procuring water shall ensure that all contracts clearly state the areas of responsibility for the supply of bunkered or tankered water and that all such provisions comply with relevant legislative requirements.

Marine and Supply Service Providers

Marine and supply service providers shall be responsible for:

- compliance with contractual conditions
- ensuring that suitable procedures are in place for the provision of clean and wholesome water delivery to BP installations whenever this service is required
- conducting audits of domestic and potable water production and management arrangements.

Health Team Leader

The Health Team Leader shall be responsible for:

- nominating a competent responsible person to prepare and maintain a documented domestic and potable water system maintenance log
- ensuring that routine monitoring of water quality is undertaken in line with legislative and BP requirements
- collating and reviewing all domestic and potable water examination results
- providing advice and assistance when water fails to meet the required standard
- providing information and advice on new or forthcoming legislation or measures to improve water quality
- ensuring that lessons learned and best practices are communicated between operational sites.

3 Water Quality Criteria

Bacteriological Quality

Analysis
Analysis shall be carried out by the BP Medical Contractor or an independent laboratory (Medical Microbiology).

Potable Water
Bacteriological samples shall initially be taken at least monthly from potable water supplies. This may be relaxed to quarterly for potable waters if six successive samples are satisfactory. Occupational Health Department may require more frequent testing if two successive samples fail the test.

Domestic Water
Water that is used for domestic supplies other than drinking and cooking shall be tested every six months.

Analysis results
In the case of an unsatisfactory result, the laboratory shall inform the Health and Safety department immediately. The Health and Safety department shall then advise the site and recommend suitable remedial action to be taken to restore water purity. The actions which will normally be recommended are detailed in *Table 1 Biological Analysis - Criteria and Actions*; more detailed advice will be provided by the Health Team upon receipt of unsatisfactory results:

Standard	Criteria (Unsatisfactory)	Action (Summary)
General bacteria count: TVC at 22C. TVC at 37C	< 100 Counts per ml. < 10 Counts per ml	1. Repeat sample(s) 2. Check Cl/ClO2 residual outlets (min 0.2ppm). 3. Further failure - increase Cl/ClO2 to 0.5ppm & maintain until satisfactory.
E.coli / total coliforms.	0 per 100 ml.	1. Do not drink/cook (i.e. only use boiled/bottled water). 2. Superchlorination of whole system including hoses ASAP as per UKOOA EH Guidelines App. VIII. 3. Repeat sampling.
Annual Legionella (all types)	<22 colony forming units / L (limit of detection	1. Showers out of bounds until sterilised (Steps 2-4). 2. Shower heads scrubbed / disinfected. 3. Thermal disinfecting of hot water system >60C (**WARNING**: SCALDING). 4. Ensure 0.5 ppm Cl/ClO2 available until superchlorination. 5. Superchlorination: 50ppm Hypo or 20ppm CLO2. 6. Resample.

Table 1 Biological Analysis - Criteria and Actions

Chemical Quality

Chemical Parameters

Chemical parameters shall be determined and compared to the standards defined within this document. Where any of the maximum acceptable levels are exceeded then advice will be given to the user by the Health Team Leader on the:

- suitability of the water for use or consumption
- possible remedial action to be taken.

Pesticides

Pesticide contamination is a serious problem with onshore water supplies in the Caucasus. Solvent extraction followed by gravimetric analysis provides only a course evaluation of pesticide levels and is subject to interference by other chemicals.
While it may be used as a course indicator, pesticide determined at levels greater than 50ug / litre by solvent extraction and gravimetric techniques must be further investigated using gas liquid chromatography to establish the nature of the compounds detected. Limits for individual pesticides shall be as per World Health Organisation Guidelines, *Annex 2 Table A2.2 C*.

Analysis

Water from all sources shall be subjected to a chemical analysis before use and thereafter annually. The full analysis in *Table 2 Chemical Contamination Limits* shall be carried out for the first test on a new water source. Thereafter the list in normal type shall be carried out on all samples.

Note: The values given in *Table 2* are guideline values based on toxicological studies and are not absolute limits. However, any potable water supply with values above the limits quoted will require further investigation before the water can be cleared for use.

Tests designated in italics will only be carried out on subsequent samples if:

- levels at or near the quoted criteria are detected in the first test
- a significant risk of contamination is determined by Health and Safety department (for example, all samples from the well at Supsa must be tested for arsenic since this is known to be present in the ground waters in this area).

Note: Potable water supplies from BP operated wells or treatment plant shall initially be tested quarterly. This can be relaxed to an annual test once consistent composition can be demonstrated.

Standard (Quarterly Test)	Criteria (prescribed concentration or value)	Significant Medical Risk
pH	6.5 – 9.5	<5.5 or >10.0
Colour	<20 mg/l (Pt/Co Scale)	-
Conductivity	<1500 uS/cm	
Turbidity	<4.0 FTU	-
Total Alkalinity*	>30 mg/l	-
Total Hardness*	>50 mg/l	-
Chloride	<250 mg/l	500 mg/l
Nitrate (NO3)	<50 mg/l	100 mg/l
Nitrate (NO2)	<3 mg/l	3.0 mg/l
Sulphate (SO4)	<250 mg/l	400 mg/l
Ammonium	<1.5 mg/l	
Chemical oxygen demand	<5.0 mg/l	
Copper	<2000 ug/l	
Magnesium (Mg)	<50 mg/l	700 mg/l
Iron	<200 ug/l	4000 ug/l
Manganese (Mn)	<50 ug/l	2000 ug/l
Calcium (Ca)	<250 mg/l	500mg/l
Lead	<10 ug/l	
Sodium	<250 mg/l	
Zinc	<3000 ug/l	
Organo chlorine pesticides	<0.5 ug/l total <0.1 ug/l individual	
Phosphorous pesticides	<0.5 ug/l total <0.1 ug/l individual	
Hydrocarbons; mineral oil	<0.3 mg/l	
Triazine herbicides	<0.5 ug/l total and individual	
Odour	3 dilution no at 25ºC	
Total dissolved solids	<1000 mg/l	
Cyanide	*<70 ug/l*	
Fluorides	*<1500 ug/l*	
Aluminium	*<200 ug/l*	
Arsenic	*<10 ug/l*	
Barium	*<700 ug/l*	
Cadmium	*<3 ug/l*	
Chromium	*<50 ug/l*	
Mercury	*<1 ug/l*	
Potassium	*<12 ug/l*	
Selenium	*<10 ug/l*	
Silver	*<10 ug/l*	

Requirements are to World health Organisation guidelines. Where no WHO guideline exists the EEC maximum admissible concentration has been used.
*For water that has been softened or desalinated.

Table 2 Chemical Contamination Limits Accidental Contamination

Incidents resulting from accidental contamination of potable water (for example, hydrocarbon tainting) should be immediately reported to the Health and Safety Department so that a co-ordinated response can be initiated. This will include arranging for appropriate water analysis and treatment advice to remove contaminant.

4 Water Quality Monitoring

Water Sampling

Water Sample Collection

Water may be supplied from:

- public mains supply
- supply vessel that has loaded the water in port
- on-site fresh water generation (for example reverse osmosis plant)
- wells
- local source by road tanker.

In all cases the quality assurance and sampling procedures are the same.
In most cases water samples will be taken by an analyst from the testing laboratory or a member of the medical team trained in water sampling.

Well Purging

If sampling well supplied water, well conditions must be stabilised by purging before taking the sample.

Note: If a well has been operating on a normal day-to-day basis, then purging of the well prior to sampling is not necessary.

For a **high yielding well**, if the well has been out of operation for more than 24 hours, remove at least three well volumes of water from the well casing.
In **moderate to high yielding wells** the purging is complete when pH and temperature have stabilised to within 10%.
For **low yielding wells** that are prone dewatering, the yield will not be restricted by parameter stabilisation and will be sampled after sufficient recharge has occurred after pumping down.
Record results of the well purging operations.

Collecting samples from taps and open pipes

Note: Avoid taking water samples from taps that have a swivel nozzle fitted or taps that leak.

The following guidelines shall apply for all samples taken from taps and pipes:

1. Remove aerators , screens or similar attachments.
2. Sterilise the end of the tap or nozzle with a small flame (a cigarette lighter is ideal).
3. Run water at a steady rate (without splashing) for at least 2 minutes before sampling
4. **Do not** adjust the flow rate while taking the sample.
5. Carefully open the sample container prior to collecting the sample and close immediately the sample has been taken.
6. **Do not** touch the mouth or inside of the container or cap and do not lay the cap down.
7. **Do not** rinse out the container.
8. Label the container as for a chemical sample and immediately refrigerate but **do not** freeze.

Collecting Samples from Tanks

Note: The risk of contaminating the sample is much higher when taking a dip sample. If possible sample from a tap rather than taking a dip sample from a tank.

To take a dip sample:

1. Hold the container at the bottom and remove the cap from the container.
2. Plunge the container mouth down into the water.
3. Tilt the container and allow to fill slowly.
4. Replace container cap immediately after collection is complete.
5. Label the container and immediately refrigerate but **do not freeze**.

Sampling Procedure for Microbiological Analysis

Because biological samples are required frequently, field staff will be asked to collect samples and despatch them to the laboratory. Microbiological samples can be easily contaminated which may lead to a false positive result. Therefore, only sample containers provided by the testing laboratory or medic may be used for microbiological samples. These containers have been sterilised prior to despatch. and must be carefully handled to prevent the introduction of bacteria from the hands or work surfaces.

In addition, sterile surgical gloves should be worn, if available, when taking samples.

Water Sampling Procedures for Chemical Analysis

Samples for chemical analysis shall be collected from a tap located on the discharge piping **downstream** of all water treatment units.

Prior to sampling for chemical analysis, the following guidelines shall be applied:

1. Check and calibrate all instrumentation required for field measurements against known standards.

   Field measurements will be made of:

   - water level in the well or storage tank
   - pH
   - temperature (^{o}C)
   - electrical conductivity (eC)
   - dissolved oxygen (DO).
2. Decontaminate all required sampling equipment.
3. Record well water or storage tank levels in order to provide a record of the groundwater / supply conditions at the time of sampling.

In addition, immediately prior to sample collection, measure and record field parameters. Field parameters are:

- pH
- temperature (^{o}C)
- electrical conductivity (eC)
- dissolved oxygen (DO).

Sample Handling, Packing and Transportation

In most instances, a chemist from the testing laboratory or a medic from the company's medical contractor will visit the site to take samples. When this is not the case the following custody and packaging guidelines must be followed:

- Samples will be stored in accordance with the requirements of the sample preservation conditions specified by the testing laboratory.
- The containers provided by the laboratory shall be used for all samples and the laboratory's instructions for taking the sample shall be strictly followed.
- After sampling, all samples will be stored in sealed sample containers in a refrigerator to maintain specified sample temperatures until transportation.

  Note: Samples will not be frozen as this may fracture glass sampling containers. Samples for metals analyses do not require refrigeration.

- Prior to transportation of the samples for analysis, the sample containers shall be packed into thermally insulated containers to maintain the specified temperatures during the transportation period.

  Note: Sample containers must be kept in refrigerated storage or an ice packed cool box during transportation.

Sample Documentation

Each sample is given a unique four-digit sample reference number. Sample information will be transferred from the field record onto the Chain of Custody Record (see *Figure 1 Water Custody Transfer Record*) which forms the basis for communications between the field and the analytical laboratory.
The Chain of Custody Record is completed by the sample taker for the analytical laboratory so that the analyst is provided with relevant sampling information. This document is completed prior to shipping the samples to the laboratory.
One copy of the completed document shall be kept by the sampler; a second copy accompanies the sample container and a third copy shall be faxed to the analytical laboratory.

SITE: **Sample taken from:**				
Field Parameters:	pH:	Temperature:	Conductivity:	Dissolved oxygen:
Time:		**Date:**		
Sampled by:		**Level marked:**		
Shipped by:	HELICOPTER ☐	SUPPLY BOAT ☐	ROAD ☐	
Shipped to:				
Packed in:	COOL BOX WITH ICE ☐	COOL BOX WITH NO ICE ☐	OTHER ☐	
Received at laboratory:				
Time:		**Date:**		
Sample still adequately chilled	YES / NO			
Bottles still full to mark	YES / NO			

Figure 1 Water Custody Transfer Record

5 Maintenance and Monitoring

The Requirement for Maintenance and Monitoring

Although the quality of water generated by reverse osmosis or distillation plant and the quality of bunkered water is generally high, it is unlikely to be entirely free of suspended solids and micro-organisms and as a result, storage and distribution systems are ultimately affected by the build-up of sediments and harmful bacteria. When conditions are favourable, harmful organisms that have colonised the system will multiply and seriously contaminated water may be released to the workplace.
An appropriate maintenance regime is essential to prevent any deterioration in water quality. Table 4 summarises the main contamination areas and the basic steps to be taken to avoid or minimise bacteriological proliferation.

Potable Water System Maintenance Log

To ensure that a suitable system of maintenance is put in place Site Managers shall identify a person from within their organisation to be responsible for producing and co-ordinating a Potable Water System Maintenance Log. In addition to the information given in *Table 1 Biological Analysis - Criteria and Actions* more detailed information may be required in the log depending on the type and complexity of the system.
Usually, a relatively simple record should suffice which should include:

- identification of those responsible
- system operating procedures and schematic/plan
- legionella risk assessment
- maintenance and monitoring procedures (including testing schedule and record keeping)
- log of monitoring data (see *Table 3 Maintenance and Monitoring Schedule*).

The log shall be regularly reviewed and updated as necessary to reflect changes and to verify that all planned preventative measures are being fully and effectively implemented.

Emergency Water Systems

In addition to the main potable water distribution system some consideration should be given to emergency services such as showers and firefighting systems involving sprinklers which may be permanently charged with water, often forming long ‘dead-legs’ and with the possibility of temperatures higher than 20ºC. However it is considered that in the event of the system being activated, the risk, especially from legionellosis (see Paragraph 6) would be insignificant compared to that from chemical contact or fire.
There may be some risk during the testing and maintenance of these systems. Therefore the control measures applied to cold water systems should be adopted so far is practicable. Testing procedures adopted should minimise the generation of aerosols, and the tests should be conducted when the minimum number of persons are likely to be affected.

Contamination Source	Action	Frequency	Monitor/Log
Bunkered/tankered supply.(supply route & source).	Flush loading line. Dedicated tanks/tanker Test water.	Each bunkering	Keep log.
Water-maker (low temp/filters etc)	As per Manufacturer's advice	Contractual Manufacturer's maintenance schedule	Appearance/taste/odour/pH/conductivity /residual chlorine. On-line sampling
Bunkering hose (lining/stagnant water).	Approved lining/stow empty/cap/sterilisation	6 monthly (sterilise Cl/ClO2 100ppm)	General fabric condition
Supplies from wells.	Keep area around well clean.	Daily	High bacteria counts will normally be seen if surface water has entered the well.
	Cut back vegetation.	Weekly	
	Exclude animals and non essential personnel.	At all times	
	Check water run off is away from well.	Monthly	
	Keep well cover shut.	Except when maintaining equipment.	
Public supplies. Contamination of water in storage tanks. Contaminated at point of supply.	Test Treat incoming water with Hypo. Use bottled water for drinking and food preparation.	Monthly Continuously	High bacteria counts if public treatment system fails or from contamination during distribution
Storage tanks/vessels (coatings/biofouling.)	Treat all incoming water with Hypo. or Chlorine dioxide (min. 0.2 ppm).	Each bunkering or continuously for company treated water.	Check chlorine or equivalent residual at least weekly
	Visual inspection	Annual	Coating condition/sediment & biofilm build-up
	Entry inspection - recoat etc as required.	5 yearly	Structure/corrosion/coating/clean/disinfect.
	Superchlorination.	On any failed bacteria test or after entry.	Bacteria test.
Calorifiers (stratification/sludge).	Temp. check (60C).	Monthly.	Temp log.
	Blow down.	Annually.	Condition.
On-line Treatment (reduced efficiency).	Autochlorination .	Weekly.	Residual chlorine(0.2ppm)
	UV units check/maintained.	As per manufactures instructions.	Trip/alarm device.
Filters/Mineralisers/ Humidifiers/Boilers (scale/biofouling).	Inspect/clean/change-out/backflush etc.	As advised by Manufactures.	Dates checked/changed.
Pipework/Dead legs/Outlets (scale/biofouling).	Water quality monitoring. Descale/disinfect shower heads. Temp check.	Scheduled sampling Monthly Monthly	Lab Results Log Hot (furthest from calorifier) 60C after 1 min. Cold (furthest from tanks) 20C.

Table 3 Maintenance and Monitoring Schedule

6 Legionella

Description and Causes of Legionnaires Disease

Legionella pneumophila is the bacteria that can cause the condition legionellosis or 'Legionnaires' disease, a severe form of pneumonia. Infection is attributed to inhaling aerosols of legionella contaminated water. Infection by drinking or person-to-person spread has not been documented. Risks of developing the disease are believed to be low due to its need for aerosols, suitable infective doses and susceptible individuals (for example those in poor health).
Legionella organisms frequently colonise domestic hot and cold water systems, particularly humidifiers, calorifiers and shower heads where they can multiply under certain conditions (for example, temperatures between 20 - 40 C, stagnant water and presence of biofilm/scale).

Risk Assessment

A Risk Assessment shall be carried out and suitable controls to prevent any harm to health must be put in place. For detailed guidance on how to assess the risks and control options available see *Paragraph 1.4 References*. Generic Risk Assessments may be used for similar installations.

Risk Reduction Strategy

The strategy to reduce the risk of legionellosis, is to design, maintain and operate water services under conditions which prevent or minimise the proliferation of legionella.

Design

- Protect systems against external contamination.
- Avoid water stagnation by careful sizing of system capacity.
- Eliminate dead legs.
- Provide efficient heating for hot water systems & adequate insulation for all pipes/fittings.
- Tanks, calorifiers etc. should be readily accessible for cleaning.

Operation

- Establish effective control levels for temperature, biocide etc.
- Ensure delivery of effective control levels by measurement.
- Maintain records of the procedures /precautions.

Maintenance

- Water system components require routine cleaning/maintenance.
- A suitable maintenance strategy is outlined in *Table 4 Legionella Control - Criteria and Actions*.

Screening For Legionella

Accommodation units with shower facilities must be sampled for the presence of legionella annually using a water sample from a shower head. The acceptance criteria are given in *Table 4 Legionella Control - Criteria and Actions*.

Standard	Criteria (Unsatisfactory)	Action (Summary)
Annual Legionella (all types)	<22 colony forming units / L (limit of detection	7. Showers out of bounds until sterilised (Steps 2-4). 8. Shower heads scrubbed / disinfected. 9. Thermal disinfecting of hot water system >60C (**WARNING**: SCALDING). 10. Ensure 0.5 ppm Cl/ClO2 available until superchlorination. 11. Superchlorination: 50ppm Hypo or 20ppm CLO2. 12. Resample.

Table 4 Legionella Control - Criteria and Actions