



Wellhead Remediation Report

1.0 Executive Summary

Introduction

This report provides a status of the wellhead characterization and remediation program as of end of year 2016 that has been and is being carried out across all of Frontera Resources Block 12 area in Eastern Georgia. Previous reports in June 2012, June 2013, April 2014, July 2015, and March 2016 have described the work being performed. Frontera began taking significant voluntary actions in 2006 on a wellhead remediation program in its Mirzaani field. This effort was expanded in 2013 to cover all of the FEGL operating fields. Work described for this expanded Block 12 wide was published in our 2014, 2015, and 2016 reports. This voluntary program is representative of Frontera's commitment to responsible stewardship of the environment in Georgia and reinforces the Company's HSEC policy and vision of "moving towards zero harm".

There have been about 500 wells drilled in FEGL Block 12 fields since the commencement of oilfield operations in the 1950's. Frontera Resources assumed operatorship of Block 12 as part of its Eastern Georgia Block 12 Production Sharing Agreement in 1997. About 250 of the wells are dismantled or abandoned; Frontera never operated any of these wells. FEGL is not aware of any of the abandoned wells presenting any substantial environmental contamination or safety risk. Of the remaining 255 wells being "managed" by FEGL there are 133 wells on production, 54 wells being swabbed, and 68 wells that are inactive.

Priority Classification System

In 2005, Frontera HSE personnel developed an environmental categorization system in order to prioritize the remediation of any oily soil locations across Block 12. The criteria included the estimated volume of oil on the ground and the surface area of oily soil. The criteria were established as follows...

- Priority 1 > 50 m² of surface oily soil
- Priority 2 10 to 50 m² of surface oily soil
- Priority 3 < 10 m² of surface oily soil

The Mirzaani field was chosen to work on first because that is where the majority of production wells in FEGL operations are located. A total of 122 "FEGL managed" wells have been identified in Mirzaani and classified. Remediation actions were begun in 2006 and continue today. These actions are described later in this report. The success of this voluntary environmental program at Mirzaani motivated FEGL to expand the program in 2013 to include all of FEGL well operations including those in its Taribani, Mtsarekhevi, Patara Shiraki, Nazarlebi, and Baida fields. There are a total of 255 "FEGL managed



wells” now in this wellhead site remediation program. The results of the entire Block 12 program are further described later in this report.

Remediation actions and results

Beginning in 2006 Frontera’s Mirzaani operations and HSE personnel have been working to control leaking wellheads and to reduce the amount of oily soil at producing wellhead sites. One primary improvement has been the replacement of stuffing boxes (equipment that is used as a seal on the pumping rod) at leaking wellhead locations. There has been significant attention to replacing and repairing stuffing boxes on the wellhead. Another source of leakage has been damage to tanks, primarily from aging/sunlight. A final source of leakage is casing leaks in a few wells; permanent fix of these problems is very problematical so our approach has been to construct containment/collection cellars to accumulate the small amount of leakage and to prevent it from getting into the environment.

The oily soil at the wellhead locations has either been mixed into the ground at the well location in order to enable insitu bioremediation to occur or has been taken to the landtreatment area of the Mirzaani or Taribani Waste Management Area (WMA).

The expansion of the program from Mirzaani to all of FEGL identified additional wellhead actions to be taken. Details of the current classification for all wells as of the end of December 2016 for each of the individual fields were compiled. Environmental management plans (EMP) were prepared in 2014, 2015, and 2016 which described remediation actions to be taken for the Priority 1 and Priority 2 well locations in all FEGL operating areas. A 2017 EMP has been prepared to establish the actions to be taken in 2017. These EMPs are prepared annually. Although they primarily address the P1 and P2 sites it is recognized that P3 sites will be addressed as time and resources are available. Annual updates are provided on this FEGL – wide wellhead remediation program with this 2017 report being the description of year end 2016 status. The status of FEGL well classification as of year-end 2016 is 3 P1, 10 P2, 89 P3 and 153 clean.

In addition to keeping records of the priority areas a picture history of the wells is being maintained to document the remediation accomplishments. Those files/records are maintained in the FEGL HSE data base management system.

2.0 History and Background of the Operations

Frontera Resources assumed operatorship of its Eastern Georgia Block 12 as consummated in the FEGL Production Sharing Agreement signed in 1997. Across all of FEGL Block 12 about 500 wells were drilled prior to the 1997 PSA. About 250 of these wells were abandoned and never operated by FEGL. As previously stated Mirzaani has 122 wells under management. At Taribani 45 wells are being managed by Frontera. At



Mtsarekhevi there are now 36 wells being managed by FEGL. At the “other” fields there are 52 wells are being managed in Patara Shiraki, Nazarlebi and Baida. Frontera has a

total of 255 wells under its management. Frontera has no responsibility for any of the ~250 wells that were drilled in Block 12 but are not part of the PSA since FEGL has not managed or operated them.

3.0 HSE Evaluation

FEGL desired a methodology to assess and categorize the “existing baseline” conditions of the well locations from an environmental perspective. A three tier classification criteria system was developed in 2005 in order to prioritize FEGL well site remediation activities. Those criteria are shown below...

Priority 1	> 50 m ² of surface oily soil
Priority 2	10 to 50 m ² of surface oily soil
Priority 3	< 10 m ² of surface oily soil

These criteria are used to describe each of the 255 wells in our annual reports.

4.0 Remediation and Mitigation Actions

There are several causes of wellhead site oily contamination. These include 1) piping leakage, 2) tanks leakage, 3) stuffing box leakage, and 4) wellhead casing leakage. All P1 and P2 locations are assessed for the root cause contributing factor to the oily soil condition. One significant causative factor in these locations was leaking stuffing boxes. FEGL has worked on installing proper stuffing boxes on its wellhead equipment for years. There are various types...soft, rigid, etc ... of stuffing boxes. An inventory of the types of stuffing boxes that exist was undertaken. An evaluation of the effectiveness of the various types of stuffing boxes was conducted. Recommendations were made and implemented.

At other locations FEGL performed repair of piping, repair of leaking storage tankage, and repair of wellhead casing during normal workover operations. At numerous locations of the P1, P2, and P3 sites repairs to leaking tanks and leaking flowlines were undertaken.

Oily soil was accumulated at each well site in the P1 and P2 category. A table was developed in 2014 which identified the volumes of contaminated oil soil that existed in the Mirzanni field. A total of about 50 cubic meters of oily contaminated soil was transported to the Mirzaani WMA. Techniques previously used at the Taribani WMA land treatment were replicated at Mirzaani. Monitoring and sampling practices are the same at Mirzaani as at Taribani. Clean closure criteria are the same as Louisiana 29B requirements. At most of the P3 locations there were only small volumes of contaminated soil so insitu bioremediation was the chosen mitigation technique.



As the wellhead remediation program expanded in 2013 to include all of FEGL this same approach of problem identification, mitigation measures defined, schedule developed, and actions taken is now being followed at the other FEGL field well locations.

5.0 Results

Results through the end of 2016 shown in Table 1 below demonstrate that since the beginning of the wellhead remediation program FEGL has been able to demonstrate a 40% reduction of its P1 sites and some reduction in the number of P2 sites. With the actions taken by this voluntary FEGL program there are 4 P1 and 10 P2 locations remaining. All of the other 255 well sites are either priority 3 or clean. It should be noted that the setback from 2015 to 2016 in progress of cleaning up P2 sites is the result of aging equipment, infrastructure, and new information. This new information probably means the figures for P1 and P2 sites in previous years was probably higher than listed. We do not have adequate information to go back and adjust these previous years.

Table 1 – FEGL wide remediation progress

	2013	2014	2015	2016
Priority 1	7	5	2	3
Priority 2	11	9	1	10
Priority 3	100	98	98	89
Clean	130	138	150	153
Total	248	250	251	255

6.0 Remaining Actions and Path Forward

There are three P1 locations and ten P2 locations in all of FEGL operating fields. One P1 location in Mirzaani represents a difficult location (on a steep hillside) for environmental remediation. The FEGL 2017 EMP has developed options for mitigation actions to reduce these P1 and P2 locations to either P3 or clean, and to maintain wellhead integrity so that additional P1 or P2 sites are not created. These actions include the following:

- Continue the evaluation and periodic replacement as needed of wellhead stuffing boxes
- Repair/replace aging and damaged tanks
- Construct containment cellars around leaking wellhead casing
- Perform an annual evaluation of the natural biodegradation process underway at a number of well locations and in particular at well # 195 - Mirzaani
- Take specific action as defined in the revised FEGL 2017 wellhead EMP on the P1 and P2 well locations at Mirzaani and Patara Shiraki fields
- Perform annual evaluation of the program; provide and publish updates



The P1, P2, P3, and clean classifications for each well location for each operating field have been compiled.

7.0 Conclusions

Frontera's voluntary wellhead remediation program is being demonstrated to be successful. The overall strategy and the specific FEGL Environmental Management Plans are providing the progress and results desired. It is recognized that because of the "newly discovered additional P1 and P2 sites" work is to be done in 2017 in order to achieve the level of remediation that we desire. Results of the program to date have been published and provided to the Georgian Government (SAOG), to NGOs, and have been published on the Frontera Resources web site HSE page. Updates on this program will continue to be published internally and pertinent results shared with Georgian Government (SAOG), NGOs, and via the Frontera Resources website.