



# Assessment and management of abandoned radioactive logging sources in Halfaya oilfield well

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**Abstract**—Each drilling operation has some degree of risk which is related to uncertainty in terms of cost overruns that may affect the feasibility to accomplish well construction operations successfully. In oil and gas wells, drilling operation is considered as most risky and highly associated with health and safety. Managing drilling risk means; small problems are not allowed to become bigger. Knowing and understanding drilling problems; their causes and solutions are necessary to reduce the overall well cost and reaching the target successfully. All drilling and well operations shall have a risk management process, which will include identification, analysis, response and control. In Halfaya oilfield in southern Iraq, problems occurred in Well HF. The wire line logging tool was stuck in the bottom of the well. Several attempts were unsuccessful to free the wire line logging tool and two radioactive logging sources had to be left in the well due to the deformation in 9% inch casing. The decision to Plug and Abandonment (P&A) Well HF was taken after numerous attempts to retrieve the radioactive logging sources. The results of investigation and analysis showed 9% inch casing deformation was occurred due to salt creeping of Lower Fars formation. In this study, Landmark (Stress Check) software was used for new casing design. It is proposed to change 9% inch casing specifications of Well HF. Re-entering this well by retrieving the lost radioactive logging tools in the hole or to sidetrack and re-drill the well to a new bottom hole location is one of the proposals for this well.

**Keywords**—Risk assessment and management , Lost in the hole tools, Casing deformation, Halfaya oilfield

## 1. Introduction

### 1.1 Risk Assessment and Management

The difference between risk assessment and risk management according to the journal of the American Society of Safety Engineers (ASSE) is as follows; risk assessment is the process by which specific problems and issues are resolved, while risk management is a term that describes the efforts of an entire organization to mitigate workplace injuries. The dichotomy is crucial to the execution of successful HSE (health, safety and environment) department efforts [1].

Risk assessment serves many purposes for an organization, including reducing operational risks, improving safety performance and achieving

objectives. While many individuals are involved in the process and many factors come into play, performing an effective risk assessment comes down to the following core element [2]:

- Risk Identification.
- Risk Analysis (Qualitative and Quantitative Analysis).
- Risk Containment (risk response planning)
- Risk Monitoring and Control.

All drilling and well operations shall have a risk management process, which will include identification, analysis, response and control. The drilling and well service managers are accountable for ensuring that any deviation from policy, established procedures and all non-routine operations have undergone a formal risk

assessment and that appropriate measures are taken to manage the risks prior to performing the operation [3].

Drilling risk management system is integrated health, safety, environment, and service quality management system, consisting of processes, standards, procedures, work methods, and forms that define how work is to be performed within companies. Drilling management system defines authorities and responsibilities for the work, and required records to be produced as evidence of execution of the work [4].

Journey to zero is companies' vision to reach zero safety incidents, zero environmental incidents and zero non-productive time. The name "Journey to zero" expresses people involved preference to acknowledge the journey, accept the challenge and make no adjustment in execution [4].

## 1.2 Drilling Problems

While drilling a well, problems will occur even in very carefully planned wells. Managing drilling risk means; small problems are not allowed to become bigger. Knowing and understanding drilling problems; their causes and solutions are necessary to reduce the overall well cost and reaching the target successfully [3].

Numerous problems obstruct the driller and the solutions may be expensive if not impossible in some cases. Making drilling decisions to correct these problems is complex processes because many factors have to be considered. Often the solutions are appropriate or specific to their implementation [5].

Oil and gas companies spend about billions of dollars annually on drilling. Unfortunately, not all of that money is well spent. A significant portion, around 15%, is attributed to losses. These include loss of material, such as drilling equipment and fluids, and loss of drilling process continuity called Non-Productive Time (NPT). These losses are incurred while searching for and implementing remedies to drilling problems. Avoiding drilling problems reduces research costs and time in finding solutions [3]. The main hole problems in southern Iraq oilfields that effect on drilling cost and performance are; lost circulation, sloughing shale, pipe sticking and casing collapse.

## 2. Study Area

Well HF in Halfaya oilfield which located in Missan governorate in the south-east of Iraq (Figure1) was selected due to drilling problems and data availability.

Halfaya oilfield is located 35 km southeast of Amarah city in Missan province (Figure1). The field is a NW-SE trending anticline structure about 30 km long, 10 km

wide, with a total area of about 288 km<sup>2</sup>. Halfaya oilfield was discovered in 1976 and then significant oil accumulations have been discovered in multiple reservoirs of Tertiary and Cretaceous formations. The Mishrif heavy oil formation is its main reservoir [6].



Figure 1: Study Area Halfaya Oilfield [7]

In vertical Well HF in Halfaya oilfield, during running 8¼ inch directional BHA through 9⅞ inch casing an obstruction occurred due to casing deformation in Lower Fars formation. Numerous attempts were made to run BHA, but they were unsuccessful. Remedial BHA was running the in hole eight times to repair deformed casing and two cement plugs were performed. Finally, the problem was fixed and well drilling operation resumed [8].

Later, logging 8 ½ inch open hole section was conducted using wire line logging tool. While logging upwards, wire line tools got stuck. Numerous attempts to get the tool free by applying maximum allowable tension, but these attempts were unsuccessful. So, fishing operation was carried out. Fishing operation was not successful, as the wire line cable was cut. While the wire line cable was pulled to surface, lost in hole (LIH) logging tools (radioactive logging sources) was observed. Fishing tools were running in the hole for sixty four times. These attempts to retrieve radioactive logging source tools were unsuccessful. Finally, the decision was taken to abandon well HF.

At present, Well HF was abandoned due to LIH two radioactive logging sources tools. In general, when such problems occur, the implemented solutions are [8]

- Retrieve radioactive logging sources tools and resume drilling operations.
- Performed cement plugs, sidetrack and re-drill the well to a new bottom hole.
- Abandon the well.

**3. Workflow Steps**

The workflow steps to achieve the aims and the objectives of this study are demonstrated as follows:

- Collecting required data for oilfield case studies; casing deformation (collapse) and Llost in the Hole (LIH) radioactive logging sources tool in Halfaya oilfield well as shown in Table 1.
- Using Landmark software to design a new casing for the selected well
- Analyze and discuss the results.
- Performing drilling risk management and contingency plan to avoid case studies problems

**3.1 Methodology Procedure**

**3.1.1 Methodology Procedure of 9 5/8 inch Casing Deformation**

The methodology procedure of 9 5/8 inch casing deformation is as follows:

- Select field and well case study.
- Prepare all data requirement , Daily Drilling Reports(DDR), Final Well Reports (FWR), Well Evaluation,Drilling Program(DP), Survey Data, Geological Report, Surface Logging Service( SLS) and Real Time Data.
- Investigate all drilling operations before and after problem occurred.
- Research the problem reasons and record all weak point while operations and mistakes.
- Review problem treatments with analyzing these treatments and report all notes or wrong decision as listing learning in future.
- Check 9 5/8 inch casing design assumptions and design.
- Record the recommendations for new casing design.
- Compare new 9 5/8 inch casing design with old design.

- Perform new 9 5/8 inch casing design for Halfaya oilfield well.
- Analyze the final data and results.

**Table 1:** Data Requirement of Two Radioactive Logging Sources Tools in Halfaya Oilfield Well

Well	Data	Purpose of Data
HF	FWR	Problem background
	FIT	Check CMT around the shoe
	DDR	Check Daily operations
	Drilling Program	Review well design
	9 5/8" CBL, MIT	Check Cement bond
	Pipe Tally	Check BHA Design
	Casing Tally	Check Casing and accessories locations
	Abandon Well Report	Check Abandon well procedure
	Fishing Report	Check fishing operation
	PT chart record	Check 9 5/8" CSG PT, and wellhead
	9 5/8" CMT Job	Review CMT Job timing and parameters
Logging tools LIH	Check type of radioactive source	

**3.1.2 Methodology Procedure of LIH Radioactive Logging Source Tool**

- The methodology procedure of LIH radioactive logging source tool is as follows:
- Select field and well case study.
- Prepare all data requirement, Daily Drilling Reports (DDR), Final Well Report (FWR), Well Evaluation, Drilling Program (DP), Survey Data, Geological Report, Surface Logging Service (SLS) and Real Time Data.
- Investigate all drilling operations before and after problem occurred.
- Research the problem reasons and record all weak point while operations and mistakes.

- Review problem treatments with analyzing these treatments and report all notes or wrong decision as listing learning in future.
- Compare all operations and procedures in this case study (Fishing, Logging, Cement Plug, Abandon the Well) with standard procedure of LIH radioactive logging source tools.
- Report final audit results with new suggestion and new plan to re-entering the well after abandonment.
- Propose recommendations.

### 3.2 Field Investigation

According to information and observations of casing deformation in Halfaya well, there are some practices that were not confirmed or apply accurately and were the cause of LIH radioactive logging source. Therefore, these information and observations are presented briefly as follows :

- Poor cement job

While performing cementing job in 9 $\frac{5}{8}$  inch casing and after pumping all displacement volume and additional volume displacement, no signal of bump plug was observed. Besides, loss of cement was observed while 9 $\frac{5}{8}$  inch casing cementing job .

- Bad casing and cement evaluation

Cement evaluation did not perform in 9 $\frac{5}{8}$  inch casing. The Cement Bond Log (CBL) or Segmented Bond Tool (SBT) log which is combined with CBL-VDL (Variable Density Log) can be run in the well before drilling a new hole to check the quality of the cement behind casing. The integrity of cement around casing shoe includes Formation Integrity Tests (FIT) and Casing Integrity Tests (CIT) did not perform .

- Annular pressure build up

While monitoring the well, it was observed annular pressure of 13 $\frac{3}{8}$  inch and 9 $\frac{5}{8}$  inch casing reach 2000 - 3000 psi. This observation indicates to poor cement bond which resulted in channels behind casings. These channels permit formation fluid to enter the well and causes a pressure build up behind the casing that lead to casing collapse.

- Casing deformation evaluation

MIT log (Multi Finger Imaging Tool) to evaluate casing deformation position and interval did not carry out. Wire line logging tools was running in the hole without PCL (Pipe Conveyed Logging) regardless 9 $\frac{5}{8}$  inch casing deformation. This process is considered unacceptable and the main cause of losing radioactive logging source tool.

- Wire line logging tool sticking

It was decided to run in the hole an open hole wire line logging, although the 9 $\frac{5}{8}$  inch casing was unstable until the last trip before running in wire line logging tool. The wire line logging tool was stuck in the bottom of the well (at total depth). Several attempts were unsuccessful to free the wire line logging tool and two radioactive logging sources had to be left in the well. Also, fishing operation to recover the radioactive logging sources was unsuccessful .

- Well abandonment:

It was decided to abandon the well after 106 days NPT. Wire line logging tool was stuck and the radioactive logging sources had to be left in the hole. Total length of wire line cable left in the hole of wire line logging tools (SGR – DLL – MSFL – DT – RHOB – NPHISP - CAL) were 61.49m and 33.81m .

A decision to Plug and Abandonment (P&A) the well was taken. The well was suspended and radioactive logging sources were isolated by performing cement plug (1.9 SG.) from 2728m to 2662m depth and high viscosity pills (Hi-Vis) between 3086m (top of the fish) to 2728m depth. Cement plug has been carried out only inside 7" casing and left open hole interval without isolation.

### 3.3 New Casing Design Proposal of Well HF

Due to casing deformation in Well HF and the information obtained from field observations, a decision was made for a new casing design. In a new casing design, detailed design; the grades of steel, weights, and coupling types were selected (changed) while preliminary design not changed.

Casing design was implemented with Landmark software. In Landmark software, mechanical design, weight and grade selection (Stress Check) was used.

#### 3.3.1 Identify Design Loads Cases

The loads to which the casing will be exposed during the life of the well will depend on the operations

to be conducted: whilst running the casing; drilling the subsequent hole section; and during the producing life of the well. These operations will result in radial (burst and collapse) and axial (tensile and compressive) loads on the casing strings. Since the operations conducted inside any particular string (e.g. the surface string) will differ from those inside the other strings (e.g. the production string) the load scenarios and consequent loads will be specific to a particular string [9].

**Collapse Load Cases**

The casing will experience a net collapse loading if the external radial load exceeds the internal radial load (Figure 2). The greatest collapse load on the casing will occur if the casing is evacuated (empty) for any reason. The collapse load, Pc at any point along the casing can be calculated from [10]:

$$P_c = P_e - P_i$$

**Burst Load Cases**

The casing will experience a net burst loading if the internal radial load exceeds the external radial load. The burst load, Pb at any point along the casing can be calculated from:

$$P_b = P_i - P_e$$

In designing the casing to resist burst loading the pressure rating of the wellhead and BOP stack should be considered since the casing is part of the well control system. The internal, Pi and external, Pe loads which are used in the determination of the burst and collapse loads on the casing are derived from an analysis of operational scenarios [11].

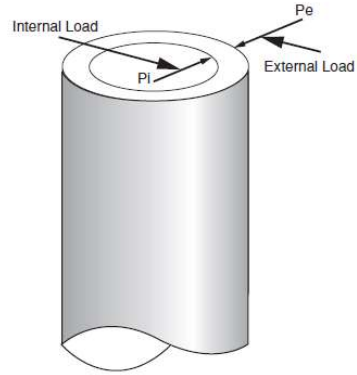


Figure 2: Radial Load of Casing [10]

**Axial Tension Load Cases**

The axial load on the casing can be either tensile or compressive, depending on the operating conditions (Figure 3). The axial load on the casing will vary along the length of the casing. The casing is subjected to a wide range of axial loads during installation and subsequent drilling and production. The axial loads which will arise during any particular operation must be computed and added together to determine the total axial load on the casing [10].

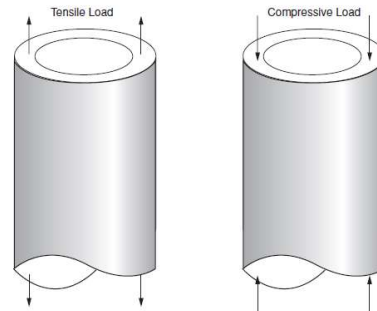


Figure 3: Axial Load of Casing [10]

3.3.2 **New Casing Design Results**

New casing design results have been presented in three parts:

- i. Casing load cases (Figure 2 through Figure 4).

- ii. Casing and connections specifications design (Table 2 and Table 3).
- iii. Actual casing design factor (Table 4).

Changing 9 5/8 inch casing weight from 47 lb/ft to 53.5 lb/ft and thread type of 9 5/8 inch and 7 inch casing from BTC to VAM TOP. To avoid the impact of salt creeping, (in Lower Fars Formation) T95 grade of 9 5/8 inch casing is proposed due to its hardness and sulphate resistance and corrosion

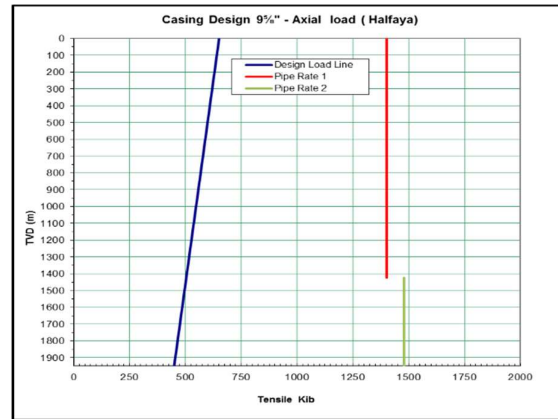


Figure 4: New Casing Axial Tension Load Case of Well HF

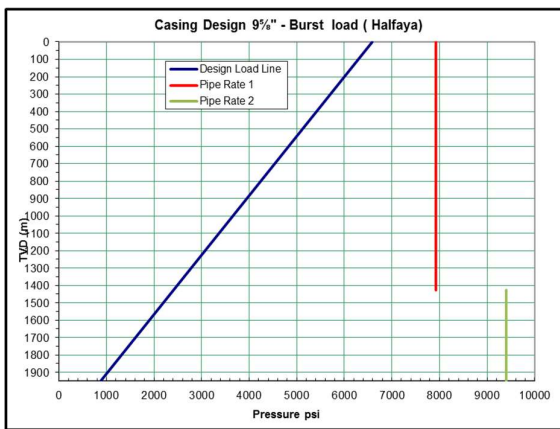


Figure 2: New Casing Burst Load Case of Well HF

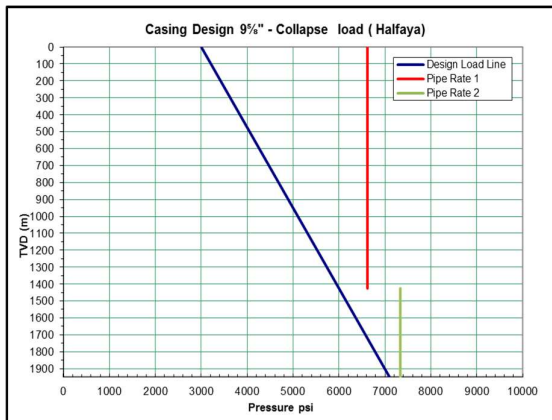


Figure 3: New Casing Burst Load Case of Well HF

Table 2: Current Casing Specification of Well HF

OD (inch)	Grade	Weight (lb/ft)	ID (inch)	Burst (psi)	Collapse (psi)	Tensile (kib)	Connection
20	K55	94	19.124	2102	522	1482	BTC
13 3/4	N80	68	12.415	5017	2262	1557	BTC
9 5/8	L80	47	8.681	6858	4765	1086	BTC
7	L80	29	6.184	8163	7018	677	BTC

Table 3: New Casing Specification of Well HF

OD (inch)	Grade	Weight (lb/ft)	ID (inch)	Burst (psi)	Collapse (psi)	Tensile (kib)	Connection
20	K55	94	19.124	2102	522	1482	BTC
13 3/4	N80	68	12.415	5017	2262	1557	BTC
9 5/8	L80	53.5	8.535	7931	6612	1400	VAM TOP
	T95	53.5	8.535	9410	7337	1478	VAM TOP
7	L80	29	6.184	8163	7018	677	VAM TOP

Table 4: New Actual Casing Design Factor of Well HF

Load Case	Minimum CSF	New Actual Design Factor of Well HF				
		20"	13 3/4"	9 5/8" L80	9 5/8" T95	7"
Burst	1.1	5.8	1.14	1.2	1.57	1.78
Collapse	1.1	2.25	1.35	1.1	1.14	1.28
Tension	1.6	8.8	5	2.2	5.2	2.7

### 3.4 Proposal Plan to Prevent Lost in the Hole Radioactive Logging Source

In well HF, standard drilling practices and drilling risk management to avoid and prevent lost in the hole two radioactive logging sources problem should be conducted and performed as follows;

- Running in the well wire line logging tools

Different types of wire line logging tools can be run in this well;

- i. In open hole interval and in high angle or horizontal wells, Pipe Conveyed Logging (PCL) tool (is attached to the end of the pipe with a connector sub) is performed when conventional wire line operations are not feasible. So, PCL tool can be used in open hole interval of this well.
- ii. Running in the hole logging while drilling (LWD) tool. Providing logs for wells which are difficult to log is one of LWD advantages.
- iii. Multi-stage (Two stages) cementing should be performed to avoid any loss or casing collapse and reduce cement thickness time.
- iv. MIT logging should be conducted to detect casing deformation position and amplitude of casing deformation failure.

- Monitoring the well

After performing 9 $\frac{3}{8}$  inch casing cementing, annuals pressure between 13 $\frac{3}{8}$  inch and 9 $\frac{3}{8}$  inch casing should be monitored and checked during all operations until the well is completed to total depth.

- Cement evaluation

Segmented Bond Tool (SBT) log should be conducted to evaluate the cement effectiveness quality and integrity behind 9 $\frac{3}{8}$  inch casing.

- Conformation for wire line operator

Do not allow wire line logging tool to reach the well bottom and more weight on the bottom should not be applied to prevent sticking.

- Conformation for well site supervisors

During first run, running radioactive logging tool is not recommended. Besides, hole conditions during running in the hole and the well under logging should be evaluated. In bad conditions, a decision should be taken to conduct a short trip for additional information or improved operating conditions.

### 3.5 Re-entering the Abandonment Well HA

Well HF was drilled to total depth 3125 m MD and 3123.61 m TVD and 7 inch casing was set to 2858 m. Well was suspended and radioactive logging sources were isolated by performing one cement plug from 2728m to 2662m depth, top of fish at 3086m depth. This study presents a proposal program to re-abandonment well HF as follows:

- i. It is important to check the radioactive contamination in the location before starting any operation as the contamination gives rise to the radiation hazard.
- ii. Nipple down Christmas tree (X-Mass tree) and nipple up and lay down tubing.
- iii. Drill cement plug from 2662m to 2728m depth. Circulation hole condition. Check radioactive contamination; positive or negative in the mud and rig site. Run in hole to top of radioactive logging source tools at 3086m depth, circulation hole and clean then check radioactive contamination in mud and rig site.
- iv. Perform first red colour cement plug from top of fish to 100m inside 7 inch casing hole. Check the hardness of cement top by applying  $\pm 10$  ton weights and conduct pressure test (1000 psi minimum). Check radioactive contamination in the mud and rig site.
- v. Set Mechanical plug at top of cement plug.
- vi. Perform second red colour cement plug from top of mechanical plug at depth 2000m depth of hole. Check the hardness of cement top by applying  $\pm 10$  tonne weights and conduct pressure test (1000 psi minimum). Check radioactive contamination in the mud and rig site.
- vii. Run in hole 3 $\frac{1}{2}$  inch tubing as kill string to 1500m depth and nipple up X-Mass tree and test it.
- viii. A permanent identification plaque must be mounted at the surface of the well. The plaque must contain: the word "Caution", the radiation symbol, the date the source was abandoned, the name of the well owner or well operator as appropriate, the well name and well identification number(s) or other designation, an identification of the sealed source(s) by radionuclide and quantity.

### 3.6 Risk Management Guidelines to Avoid Lost in the Hole Radioactive Logging Source during Drilling Operations

To avoid lost in the hole radioactive logging source in Well HF, best risk management, best available techniques (BAT) and best drilling practice regardless of cost were selected as explained below;

- Wellbore quality (WQ)

A high-quality well begins with a good well plan, analysing potential improvements, analysing mistakes and success from previous projects, assessing new technologies and strategies.

- Open hole logging tools

The well is logged while it is being drilled with logging while drilling (LWD) tools. Using LWD tools permit; data availability during drilling, providing logging for wells that are difficult to log and easier in selecting casing or core point. LWD tools run in the hole only for one trip, so the risks for losing these tools in the hole are reduced. Also, pipe conveyed logging (PCL) tools can be used which are attached to the end of the pipe with a connector sub and provide very good logs. Logging with PCL tools is a slow trip and take significantly more time than other wire line conveyed logs.

- Hole cleaning

Inadequate and poor hole cleaning cause many and costly drilling problems such as; pipe sticking, slow drilling rate, excessive torque and drag, difficulties in running casing and logging tools and difficulties in cementing. So, keeping the hole clean is an important issue.

- Logging and drilling confirmation and recommendations
  - i. Do not allow the tools to reach the bottom or applying more weight on the bottom to prevent wire line sticking during running in the hole wire line logging tools.
  - ii. Radioactive logging tools should not be run in the hole during first run.
  - iii. Evaluate the hole condition as in bad conditions a short trip should be conducted.
  - iv. Check all certificates and inspections reports for all wire line tools and logging unit. Also, check wire line cable inspections according to client and service drilling company's policy.

- v. All activities in the well site are risk assessed and require job safety analysis (JSA) and permit work.

- Contingency plan

Contingency plan should be ready and reviewed in case of any problem event occurs such as wire line sticking and lost logging tools in the well. In contingency planning, the time is saved through maintaining and keeping good hole conditions.

### 3.7 Contingency Plan for Lost in the Hole Radioactive Logging Source during Drilling Operations

Contingency plan should be prepared before project or job starts and signed off between drilling company and client, it needs to be reviewed and agreed before the job. Tools and equipment, logging unit, fishing equipment and personal in charge will be ready all the time in case wire line sticking or parting.

When the radioactive logging source is losing in the hole, the contingency plan is as follows:

- i. In case a radioactive source became stuck down hole, tool recovery should be conducted by the customer per the company master service agreement.
- ii. A reasonable effort at recovery should be made by the customer when radioactive logging source is lost in the hole.
- iii. No attempt to recover a sealed source should be conducted in a manner that could result in a source rupture.
- iv. In case any radioactive source that has been ruptured or is likely to be ruptured, immediate notification to the Global Radiation Safety Group shall be made.

## 4. Lost in the Hole Radioactive Logging Source Risk Assessment and Management Worksheet

Risk assessment and management plan to avoid Lost in the hole two radioactive logging source in Halfaya oilfield well is illustrated in Table 5a though Table 5c.



## 5. Conclusions

1. To avoid the impact of salt creeping on 9 $\frac{5}{8}$ " casing, increase casing weight to 53.5 lb/ft , change casing grade to T95 and increase casing design safety factor of collapse and burst load case is proposed.
2. Running in Logging While Drilling (LWD) tools reduce the risks for losing these tools in the hole. Also, Pipe Conveyed Logging (PCL) tools can be used to provide very good logs.
3. Before drilling the new hole section, perform Formation Integrity Tests (FIT) and Casing Integrity Tests (CIT) to evaluate the cement bond strength around 9 $\frac{5}{8}$  inch casing shoe. Also, running in Cement Bond Log (CBL) or Segmented Bond Tool (SBT) log to evaluate the cement effectiveness quality and integrity behind a cemented casing (accurate evaluation of a casing cement job).
4. Well design optimization, perfect drilling practises, select excellent casing manufactures and improving the accuracy of cement evaluations would prevent casing deformation in future.
5. Client should use the accurate tools and equipment to conduct tests while drilling. Training the crew to learn how to manage risks is the client responsibility.
6. Monitor and check the radioactive contamination in the abandonment well in Halfaya oilfield before starting any operation as the contamination gives rise to the radiation hazard.
7. Re-entering abandonment well HF in Halfaya oilfield, by retrieving the LIH radioactive logging sources or to sidetrack and re-drill the well to a new bottom hole location. This proposal depends on hole conditions, risk analysis, drilling time and cost analysis .

Table 5a: Risk Assessment Worksheet of Halfaya Oilfield

Area : Missan			Field : Halfaya			Well : HF		
Description of Work Activities: Lost Radioactive source logging tools in Halfaya oilfield								
L - LIKELIHOOD			S - SEVERITY			R - Risk Level		
Category	Definition	Category	Definition			LIKELIHOOD		
LOW (1)	Remote	LOW (1)	Minor Injury	No Damage	No Pollution	L 1	2	3
MEDIUM (2)	Possible	MEDIUM (2)	Serious Injury	Minor Damage	Minor Pollution	M 2	4	6
HIGH (3)	Probable	HIGH (3)	Major Injury	Major Damage	Major Pollution	H 3	6	9
						L	M	H
								RESULT
								Acceptable
								Tolerable
								Unacceptable

No.	Hazards Identified	Hazard Effects	Potential Risk level			Mitigation Plan	Control Measurement (Contingency)	Residual Risk level			Results
			L	S	R			L	S	R	
1	Stuck two radioactive logging source tools in Halfaya oilfield due to 9% inch casing deformation Logging tools stuck : SGR – DLL – MSFL – DT – RHOB – NPFI – SP – CAL	Lost in the hole two radioactive logging source tools Tools lost in the hole : 1- Neutron Smart Release Tool (NSRT) 2- Gamma ray Spectrometry tool (SGR)	3	3	9	Conduct perfect hole condition.	In case sealed source became stuck down hole, the recovery shall be conducted by the customer per the company Master Service Agreement.	2	1	2	Acceptable

**Table 5b: Risk Assessment Worksheet of Halfaya Oilfield**

No.	Hazards Identified	Hazard Effects	Potential Risk level			Mitigation Plan	Control Measurement (Contingency)	Residual Risk level			Results
			L	S	R			L	S	R	
1	Stuck two radioactive logging source tools in Halfaya oilfield due to 09% inch casing deformed. Logging tools stuck : SGR – DLL – MSFL – DT – RHOB – NPHI – SP – CAL	Abandon the well	3	3	Run in hole logging tools with PCL in case have casing deformation and fixed.	No attempt to recover sealed source should be conducted in a manner that could result in a source rupture.	2	1	2	Acceptable	
		88 days Non Productive time									
		Cost lost 10.2 MM \$									

Table 5c: Risk Assessment Worksheet of Halfaya Oilfield

No.	Hazards Identified	Hazard Effects	Potential Risk level			Mitigation Plan	Control Measurement (Contingency)	Residual Risk level			Results
			L	S	R			L	S	R	
1	Stuck two radioactive logging source tools in Halfaya oilfield due to 9% inch casing deformed. Logging tools stuck : SGR – DLL – MSFL – DT – RHOB – NPFI – SP – CAL	HSE & Environment effect in future	3	3	9	Perform MIT log to check casing deformed position	Preparing all document and risk management worksheet	2	1	2	Acceptable

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LM	Landmark
LWD	Logging While Drilling
MD	Measure Depth
MIT	Multi Finger Imaging Tool
MSFL	Micro Spherical Log
NPHI	Natural Neutron Log
NPT	Non Productive Time
NW	North West Direction
P&A	Plug and Abandonment
PCL	Pipe Conveyed Logging
PP	Pore Pressure
RHOB	Density Log
SBT	Shoe Bond Test
SE	South East
SG	Specific Gravity
SGR	Spectral Gamma Ray
SLS	Surface Logging Services
TVD	True Vertical Depth
VDL	Variable Density Log
WQ	Wellbore quality

## Nomenclatures

ASSE	American Society of Safety Engineers
BAT	Best Available Technique
BHA	Bottom Hole Assembly
BTC	Buttress
CAL	Calliper Log
CBL	Cement Bond Log
CIT	Casing Integrity Tests
DDR	Daily Drilling Report
DLL	Dull Lateral Log
DP	Drilling Program
DT	Sonic Log
FIT	Formation Integrity Test
FP	Fracture Pressure
FWR	Final Well Report
HF	Halfaya
JSA	Job Safety Assessment
LIH	Lost In Hole

## تقييم وإدارة ترك المصادر المشعة لمعدات تقييم الآبار في بئر حقل حلفاية النفطية

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**الخلاصة** - كل العمليات التي تجرى في الآبار النفطية والغازية لديها درجة معينة من المخاطر التي تتعلق بعدم اليقين من حيث تجاوز التكاليف التي قد تؤثر على جدوى إنجاز عمليات الآبار بنجاح. في آبار النفط والغاز، تعتبر عملية الحفر الأكثر خطورة ومرتبطة بشكل كبير بالصحة والسلامة. إدارة مخاطر الحفر تعني عدم السماح للمشاكل الصغيرة أن تصبح أكبر. من حيث معرفة وفهم الأسباب والحوادث الضرورية لمشاكل الحفر وذلك لتقليل التكلفة الإجمالية للبئر والوصول إلى الهدف بنجاح. جميع عمليات الحفر والعمليات الأخرى في الآبار يجب أن تتضمن على عملية إدارة المخاطر، والتي تشمل التحديد، التحليل، الاستجابة والتحكم. في حقل حلفاية النفطية في جنوب العراق، حدثت مشاكل في البئر Well HA، حيث حدث استعصاء لأداة التسجيل السلبي Wire line logging tool في قاع البئر. تم إجراء عدة محاولات لتحرير أداة التسجيل السلبي ولكنها بانته بالفشل ونتيجة لهذا، ترك مصدرين للتسجيل المشع في البئر بسبب التشوه في البطانة ذات حجم 9% عقدة. بعد محاولات عديدة غير ناجحة لاسترداد مصدر التسجيل المشعة، تم اتخاذ قرار عمل سداد اسمنتي وهجر البئر Well HA. في هذه الدراسة، أظهرت نتائج الاستقصاء والتحليل حدوث تشوه في البطانة ذات حجم 9% عقدة بسبب زحف الملح لتكوين فارس السفلى Lower Fars Formation. بالإضافة إلى ذلك، لم يتم تنفيذ فحوصات التكوين المتكامل (FIT) واختبارات سلامة البطانة (CIT) ولم يتم انزال معدانتقويمصلايه الأسمنت (CBL) أو فحوصات صلابه الأسمنت اسفل البطانه (SBT) في تجويف البئر. تضمنت هذه الدراسة استخدام برنامج Landmark (Stress Check) لتصميم جديد للبطانة ومن خلالهم اقتراح تغيير مواصفات البطانة 9% عقدة للبئر Well HF. كذلك اقترح إعادة حفر البئر بعد هجره عن طريق استرجاع مصادر التسجيل المشعة التي تركت في تجويف البئر أو الانحراف عن مسار البئر الأصلي بحفر تجويف جديد (Sidetrack) إلى موقع جديد لقاع البئر. بالإضافة إلى مراقبة وفحص التلوث الإشعاعي في البئر المهجور في حقل حلفاية النفطية قبل البدء في أي عملية حتى لا يؤدي التلوث إلى خطر الإشعاع. لتجنب ضياع مصدر التسجيل الإشعاعي في تجويف البئر Well HF، يجب اختيار أفضل إدارة للمخاطر وأفضل التقنيات المتاحة (BAT) وأفضل ممارسات الحفر بغض النظر عن التكلفة. أيضاً، يجب أن تكون خطة الطوارئ جاهزة ومراجعتها في حالة حدوث أي مشكلة في البئر.

**الكلمات الرئيسية** - تقييم وإدارة المخاطر، فقدان المعدات في تجويف البئر، تشوه البطانة، حقل حلفاية النفطية