Anticollision and Risk Management Offshore Qatar: A Successful Collaboration

IPTC -131422 - PP

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Factors Driving Anticollision Development

- More complex drilling programs
- Densely populated subsurface environments
- Missing or inaccurate legacy data
- High cost of catastrophic failure

Typical Subsurface Environments

The Challenge of Collaboration

- No industry-wide anticollision standard
- Different standards define risk differently
  - Differ in methods for evaluating/reducing risk
  - Differ in amount of risk deemed acceptable
- A hybrid approach requires
  - Careful planning
  - Integration/bridging of methodologies
  - Effective communication
  - Team work

Case Study Offshore Qatar

Operator's Drilling Environments

- Wells drilled in close proximity
- 20-in conductors, vertical and deviated
- Uncontrolled conductor direction/inclination
- Risk of tophole collisions increased

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Challenges

- Different directional databases
- Different anticollision procedures and error models

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- Different databases, software
  - Contractor – proprietary software
  - Operator – commercial software
- Advantage in catching potential errors
  - Incorrect survey entered
  - Missing survey
  - Incorrect sidetrack point
  - Incorrect rotary table elevation
  - Incorrect survey tool model assigned

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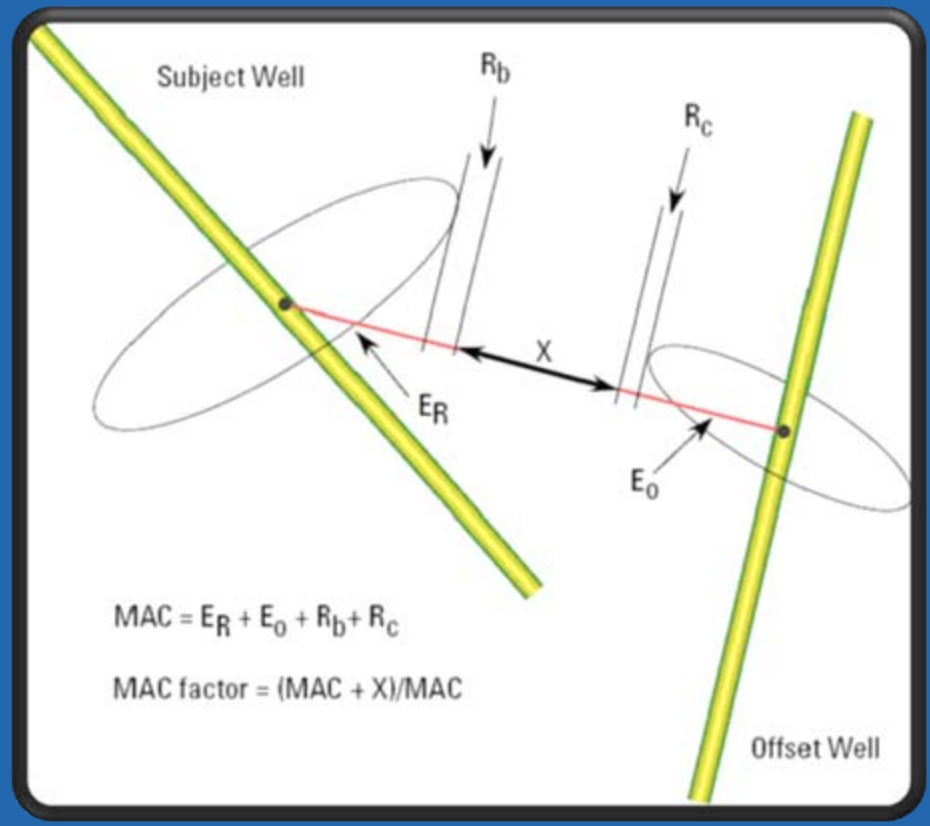
Resolving Differences in Anticollision Standards

- Extensive pre-job planning to identify potential issues
- Established plan to meet both companies' standards
- Followed both company and operator's rules for exemptions
- Independent calculations performed throughout execution
- No actions that would pose HSE risks

Key Differences in Calculating Risk

Operator ‘s Minimum Acceptable Clearance (MAC)

- Results are less conservative than company’s OSF



Key Differences in Calculating Risk

$MAC = E_R + E_O + R_O + R_c$

Where:

E_R = Projection of the Error Ellipse (subject well) on line of closest approach

E_O = Projection of the Error Ellipse (offset well) on to the line of closest approach

R_O = Bit radius (reference well)

R_c = Casing radius (offset well)

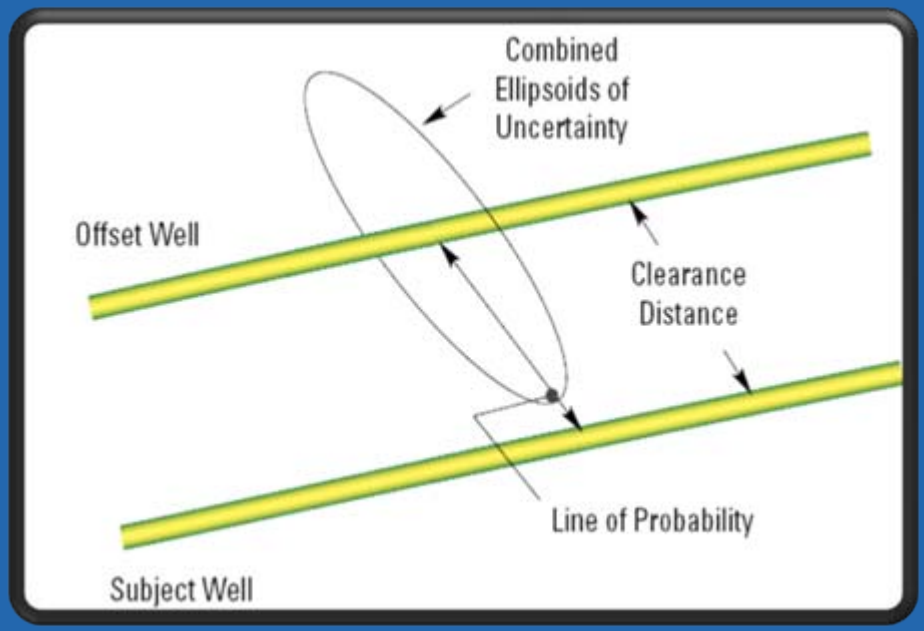
X = Additional clearance beyond MAC

MAC factor =

$(MAC + X) / MAC = (MAC + X) / (E_R + E_O + R_b + R_c)$

Key Differences in Calculating Risk

Company's Oriented Safety Factor (OSF)

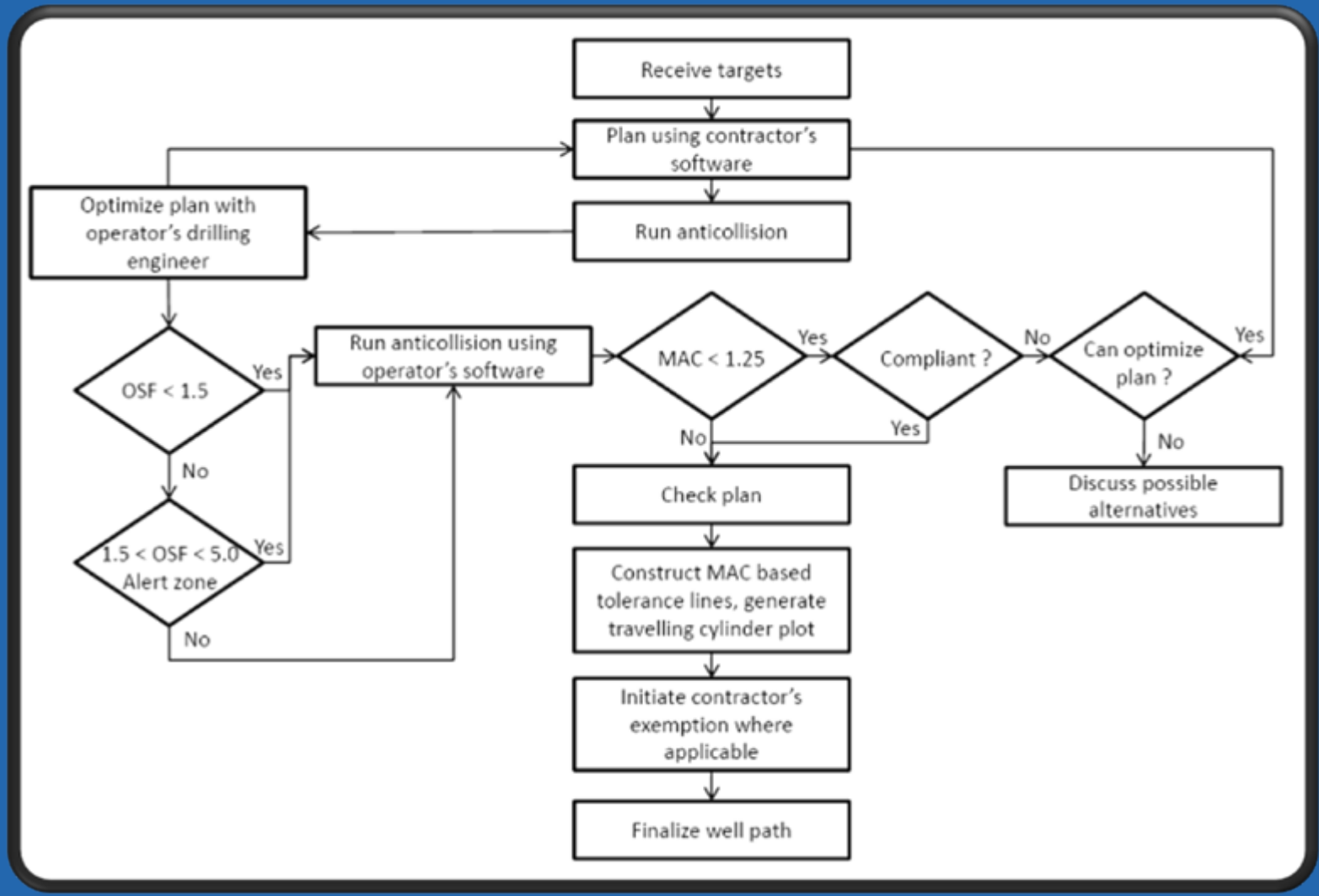


OSF	Probability
2.0	750,599,937,895,083
1.5	660,669,956
1.2	954,910
1.1	146,076
1.0	25,959
0.8	669
0.5	42
0.3	9

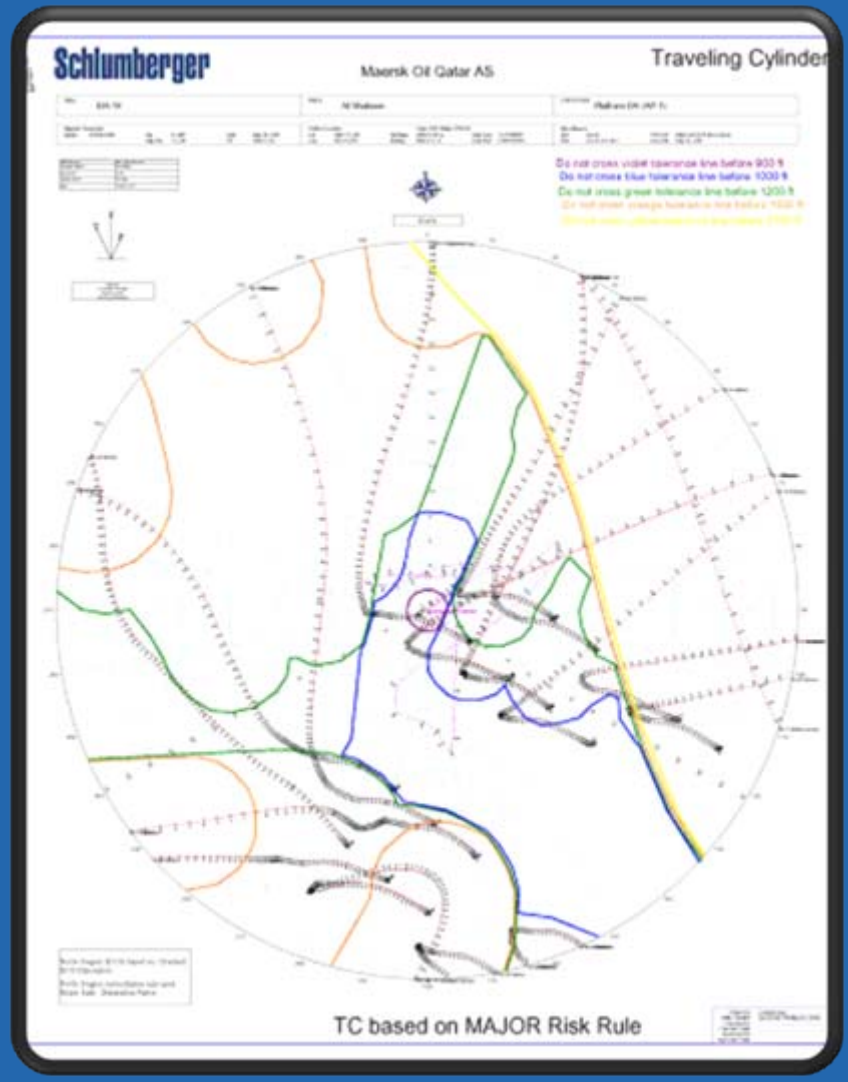
Key Differences in Calculating Risk

Comparison of Methods		
	Operator Procedure	Contractor Procedure
Separation factor	Minimum Acceptable Clearance (MAC) Factor	Oriented Separation Factor (OSF)
Minimum separation	$= E_R + E_O + R_b + R_c$	Minimum Allowable Separation (MAS) at OSF = 1.5
Drill ahead with precautions	1.5> Factor>1.25	1.5>OSF>1.0 (Exemption required as per contractor standard
Drill ahead	Factor>1.5	OSF>1.5
Tool error model	ISCWSA 2σ 74% confidence level (3D)	ISCWSA 2.79σ 95% confidence level (3D)

Well Planning Process

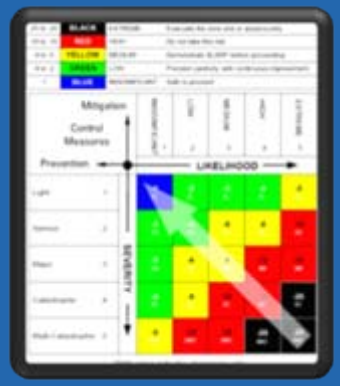


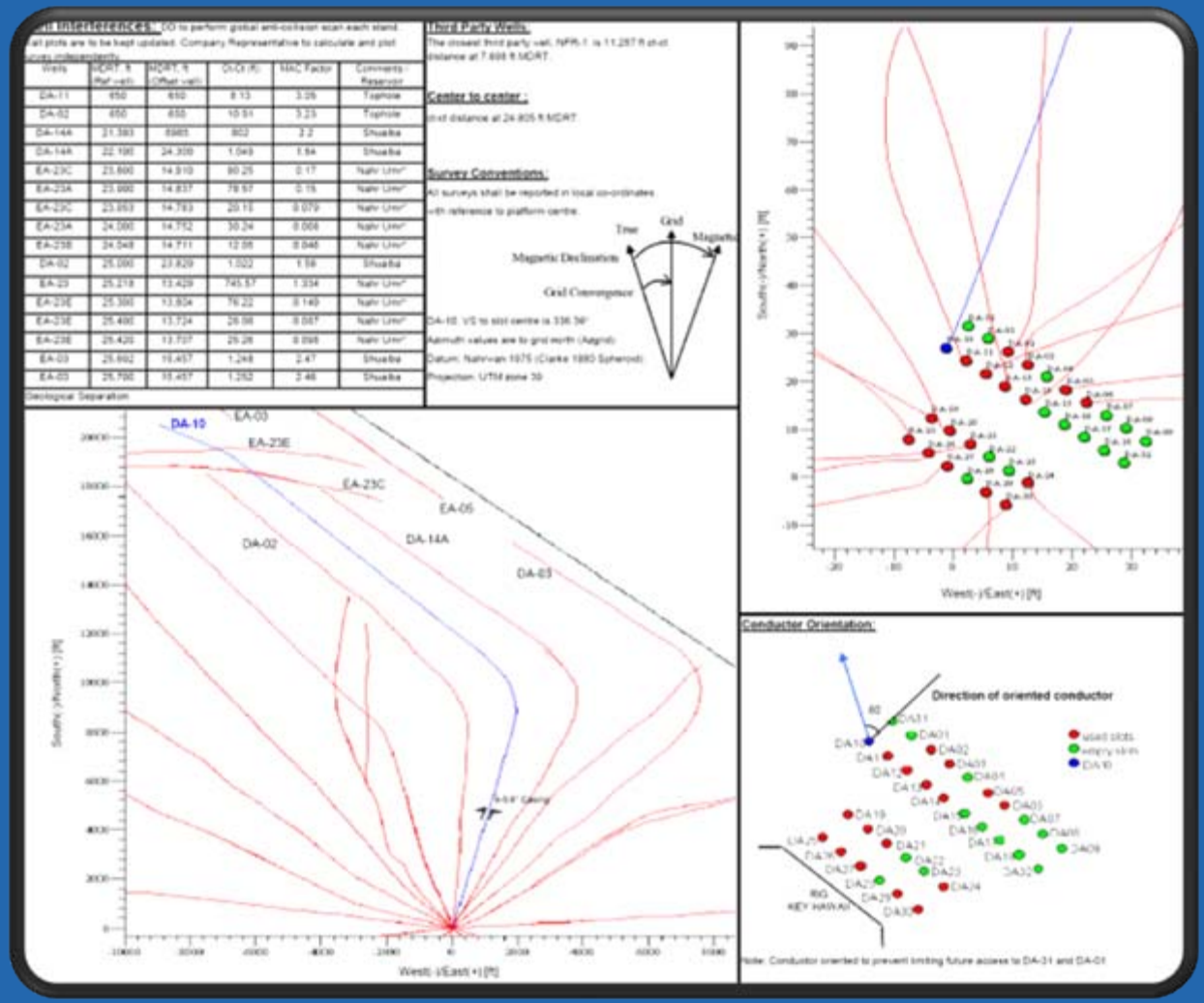
Traveling Cylinder Plot



Well Design Phase

Hazard and Risk Control



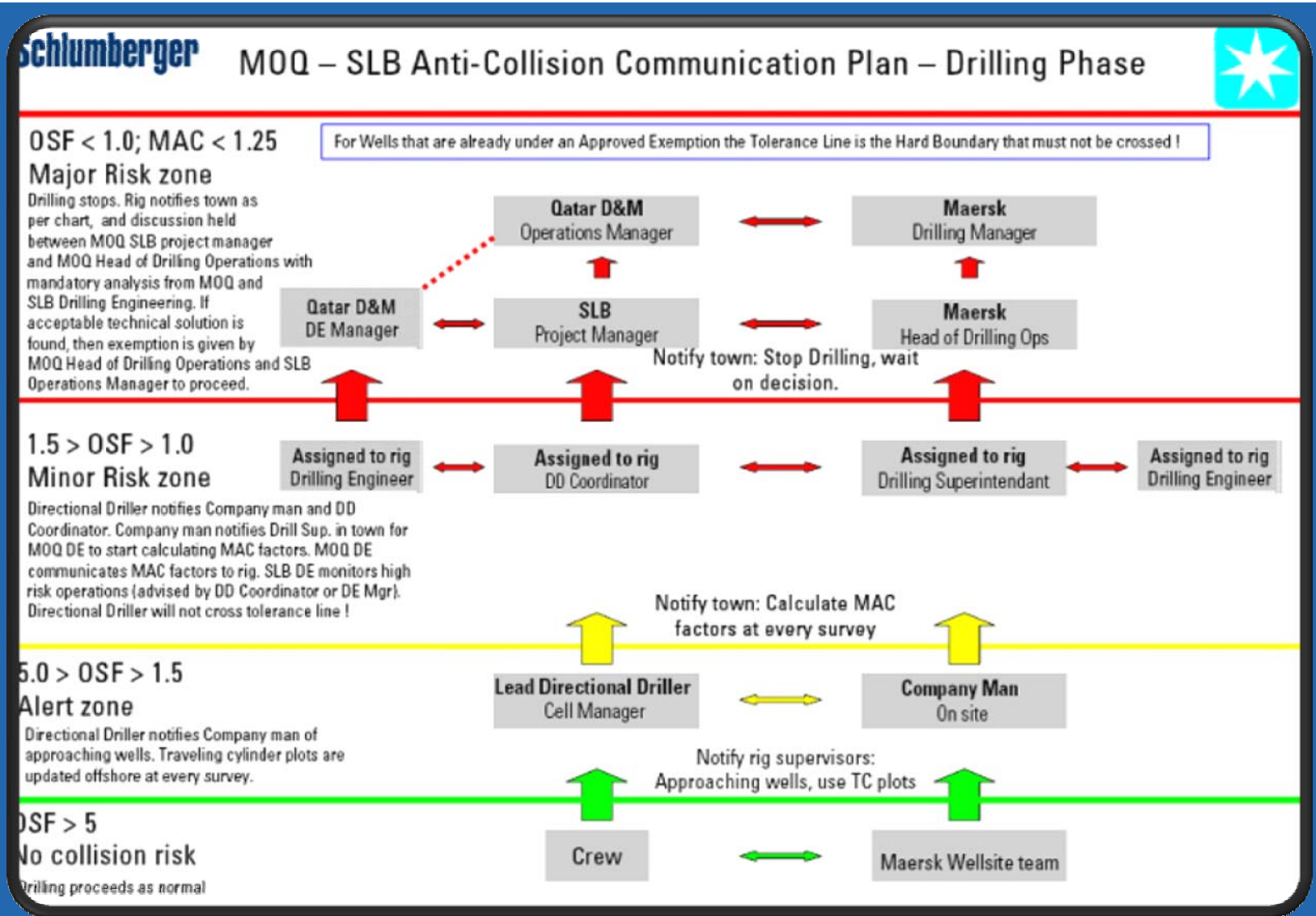


Well Execution Phase

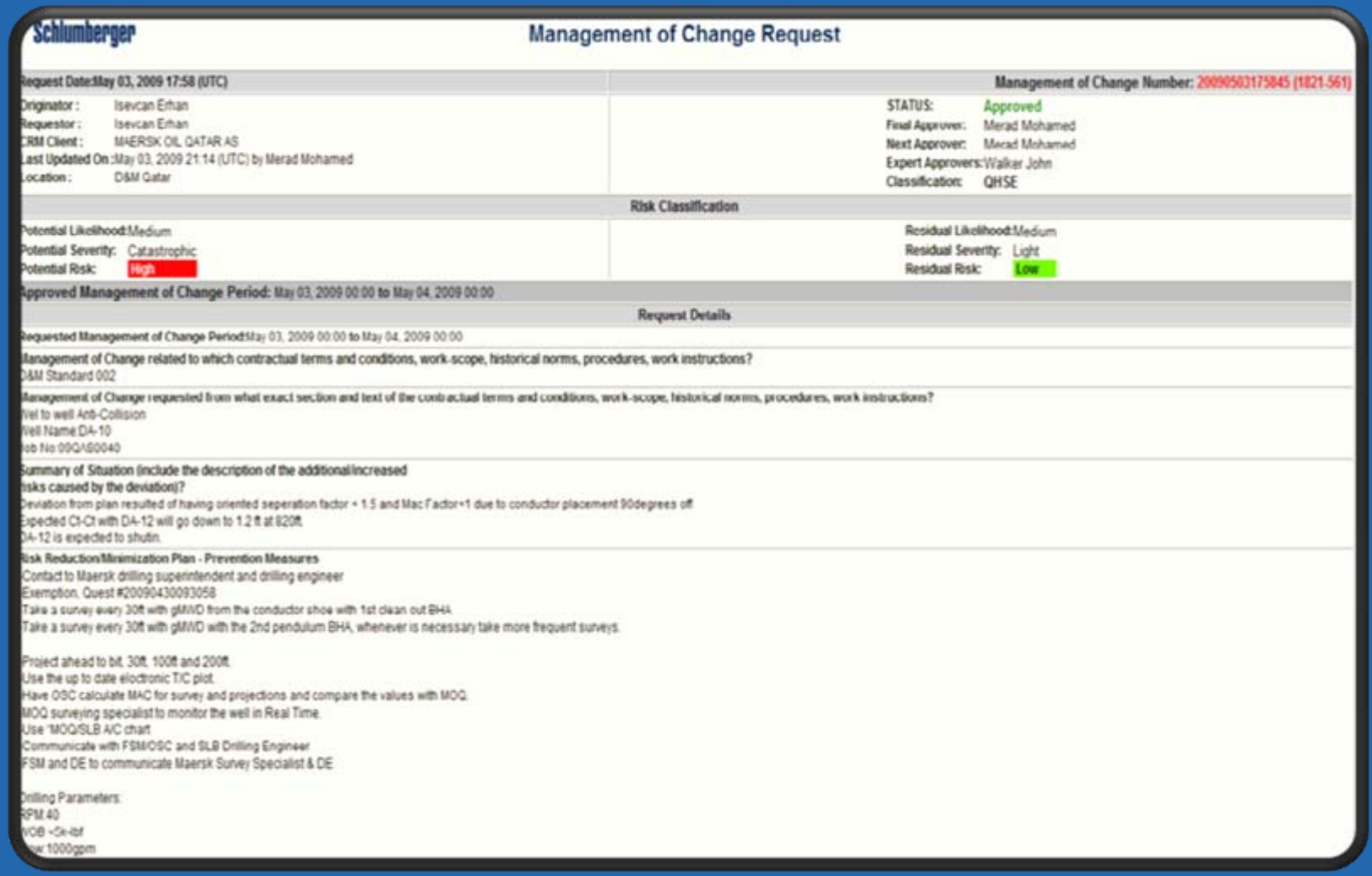
Prespud Meeting

- Held prior to commencement of drilling
- Includes discussion of:
  - Well objectives
  - Well plan
  - Anticollision issues
    - Preventive and Mitigation actions

Well Execution Phase



Well Execution Phase



Schlumberger

Management of Change Request

Request Date: May 03, 2009 17:58 (UTC)

Management of Change Number: 20090503175845 (1821.561)

Originator :	Isevcan Erhan	**STATUS:**	Approved
Requestor :	Isevcan Erhan	**Final Approver:**	Merad Mohamed
CRM Client :	MAERSK OIL QATAR AS	**Next Approver:**	Merad Mohamed
Last Updated On :	May 03, 2009 21:14 (UTC) by Merad Mohamed	**Expert Approvers:**	Walker John
Location :	D&M Qatar	**Classification:**	QHSE

Risk Classification

Potential Likelihood:	Medium	**Residual Likelihood:**	Medium
Potential Severity:	Catastrophic	**Residual Severity:**	Light
Potential Risk:	High	**Residual Risk:**	Low

Approved Management of Change Period: May 03, 2009 00:00 **to** May 04, 2009 00:00

Request Details

Requested Management of Change Period: May 03, 2009 00:00 to May 04, 2009 00:00

Management of Change related to which contractual terms and conditions, work-scope, historical norms, procedures, work instructions?

D&M Standard 002

Management of Change requested from what exact section and text of the contractual terms and conditions, work-scope, historical norms, procedures, work instructions?

Rel to well Anti-Collision
Well Name DA-10
Job No 09QAS0040

Summary of Situation (include the description of the additional/increased risks caused by the deviation)?

Deviation from plan resulted of having oriented seperation factor < 1.5 and Mac Factor<1 due to conductor placement 90degrees off
Expected Ct-Ct with DA-12 will go down to 1.2 ft at 820ft.
DA-12 is expected to shutin.

Risk Reduction/Minimization Plan - Prevention Measures

Contact to Maersk drilling superintendent and drilling engineer
Exemption, Quest #20090430093058
Take a survey every 30ft with gMWD from the conductor shoe with 1st clean out BHA
Take a survey every 30ft with gMWD with the 2nd pendulum BHA, whenever is necessary take more frequent surveys.

Project ahead to bit, 30ft, 100ft and 200ft.
Use the up to date electronic T/C plot.
Have OSC calculate MAC for survey and projections and compare the values with MOQ.
MOQ surveying specialist to monitor the well in Real Time.
Use 'MOQ/SLB A/C chart
Communicate with FSM/OSC and SLB Drilling Engineer
FSM and DE to communicate Maersk Survey Specialist & DE

Drilling Parameters:
RPM:40
WOB <5k-lbf
Flow:1000gpm

Well Execution Phase

- Gyro survey of subject well conductor e-mailed to:
  - Operator's
    - Drilling superintendent
    - Drilling Engineer
    - Survey specialist
  - Contractor's
    - Drilling service manager
    - Drilling engineer
    - Survey specialist
    - OSC personnel

Well Execution Phase

MAC factor calculations sent from OSC to Operator:

DA-10 MAC Calculation 16" Section

Critical offset wells

Survey			Remarks	DA-02		DA-03		DA-05		DA-05A		DA-06		DA-11		DA-12A		DA-12B		DA-12E		DA-13		DA-13A		DA-14	
MD	Inc	Azm		C-C	MAC	C-C	MAC	C-C	MAC	C-C	MAC	C-C	MAC	C-C	MAC	C-C	MAC	C-C	MAC	C-C	MAC	C-C	MAC	C-C	MAC	C-C	MAC
300.00	0.11	322.68	Gyro Survey																								
325.00	0.10	160.22	Gyro Survey																								
350.00	0.40	130.29	Gyro Survey																								
375.00	0.73	123.15	Gyro Survey																								
400.00	1.22	118.69	Gyro Survey																								
425.00	1.65	120.11	Gyro Survey																								
450.00	2.03	121.96	Gyro Survey																								
475.00	2.13	117.84	Gyro Survey																								
500.00	2.09	109.67	Gyro Survey																								
525.00	2.03	99.55	Gyro Survey																								
550.00	1.91	93.52	Gyro Survey																								
585.00	1.04	108.13	Gyro Survey																								
601.00	0.90	113.34	GMWD Survey																								
637.00	0.51	172.93	GMWD Survey																								
662.00	0.52	170.73	GMWD Survey																								
673.00	0.52	210.02	GMWD Survey	3.82	1.528	6.72	2.541							3.36	1.384	2.72	1.062	2.72	1.062	2.72	1.062	5.200	2.025	6.210	2.587	10.590	4.466
708.00	0.34	134.61	GMWD Survey	4.01	1.506	6.83	2.399							3.46	1.335	2.24	[illegible]	2.24	[illegible]	2.24	[illegible]	5.070	1.838	6.160	2.381	10.610	4.144
737.00	0.43	152.54	GMWD Survey	4.32	1.542	7.12	2.367							3.70	1.349	1.74	[illegible]	1.74	[illegible]	1.74	[illegible]	4.890	1.669	6.040	2.204	10.550	3.890
[illegible]	CLOSEST POINT AT APPROACH															[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
837.00	0.40	152.00	Proj	7.49	2.232	10.92	2.983							6.08	1.587	1.94	[illegible]	1.94	[illegible]	1.94	[illegible]	4.070	1.142	6.300	1.604	10.280	3.151

OSC-QTG

Operation Support Center

Appreciates your co-operation, determination & commitment to help us improve our service quality

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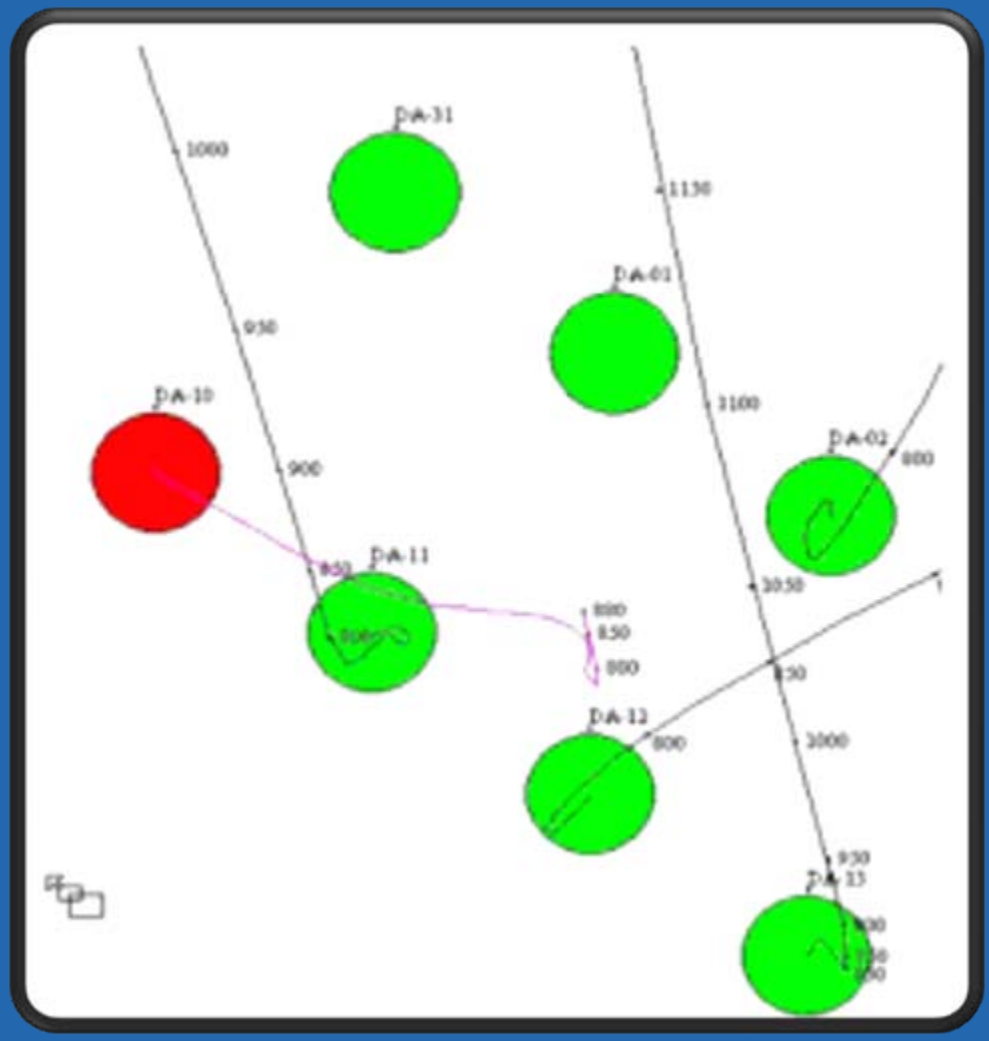
Well Execution Phase



Well Execution Phase

- Contractor DSM confirms drill-ahead decision
- Failing confirmation:
  - Additional meetings may be planned to analyze options
  - Agreement is reached on prevention/mitigation strategies
  - Well is re-planned to minimize well collision risk

Well Execution Phase

Preventive Actions While Drilling:

- Monitor indications such as high/erratic torque, ROP change, bit vibration, etc.
- Monitor object well at wellhead for indications of bit in contact with casing.
- Monitor returns for cement.
- Install magnet in flow line to monitor for metal cuttings/shows.
- Check MWD surveys for magnetic interference.
- Take survey when bit ≤ 5 ft from critical point.

Well Execution Phase

When to shut in wells:

- Critical offsets shut in as specified by drilling program.
- Additional wells shut in, bled off, when:
  - Deviation results in MAC factor < 1.25 (actual or projected)
- Drilling ceases, object well plugged back, when:
  - Object well falls within MAC factor < 1.0 toward any well

Post-Drilling Evaluation

Key personnel meet to:

- Identify problem areas
- Identify good practices
- Document and share lessons learned

Conclusion

Keys to success:

- Comprehensive planning
- Good communication strategy
- Multidisciplinary collaboration

Conclusion

Advantages of an Industry-wide Standard

- Enhanced interoperability among project participants
- Reduction of risks due to:
  - Miscommunication
  - Different terminologies
  - Different methods of calculating risk

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