



www.RigDeluge.com

1. Eliminate

(remove the cause of the danger completely)

2. Substitute

(replace the hazardous work practice or machine with an alternative)

3. Isolate

(separate the hazard from the people at risk from injury)

4. Engineer Controls

(physical changes, e.g. redesign machine by adding safeguards)

5. Administrative Controls

(install signs, rotate jobs, etc.)

6. PPE

(provide gloves, earplugs, etc.)

Do not simply choose a control method because it is easy and fast to implement

Hierarchy of Controls

(In Order of Importance)

✗	Eliminate	✓
✗	Substitute	✓
✗	Isolate	✓
✗	Engineered	✓
✓	Administrative	✓
✓	PPE	✓

RigDeluge®

Engineered Safety Innovations

(Patented & Patents Pending)

Introducing Hazards & Risks by using Administrative Controls to allow it or use an Engineered Safety Innovation to Mitigate & Reduce Hazards and Risks?



Hierarchy of Controls

(In Order of Importance)

✗	Eliminate	✓
✗	Substitute	✓
✗	Isolate	✓
✗	Engineered	✓
✓	Administrative	✓
✓	PPE	✓

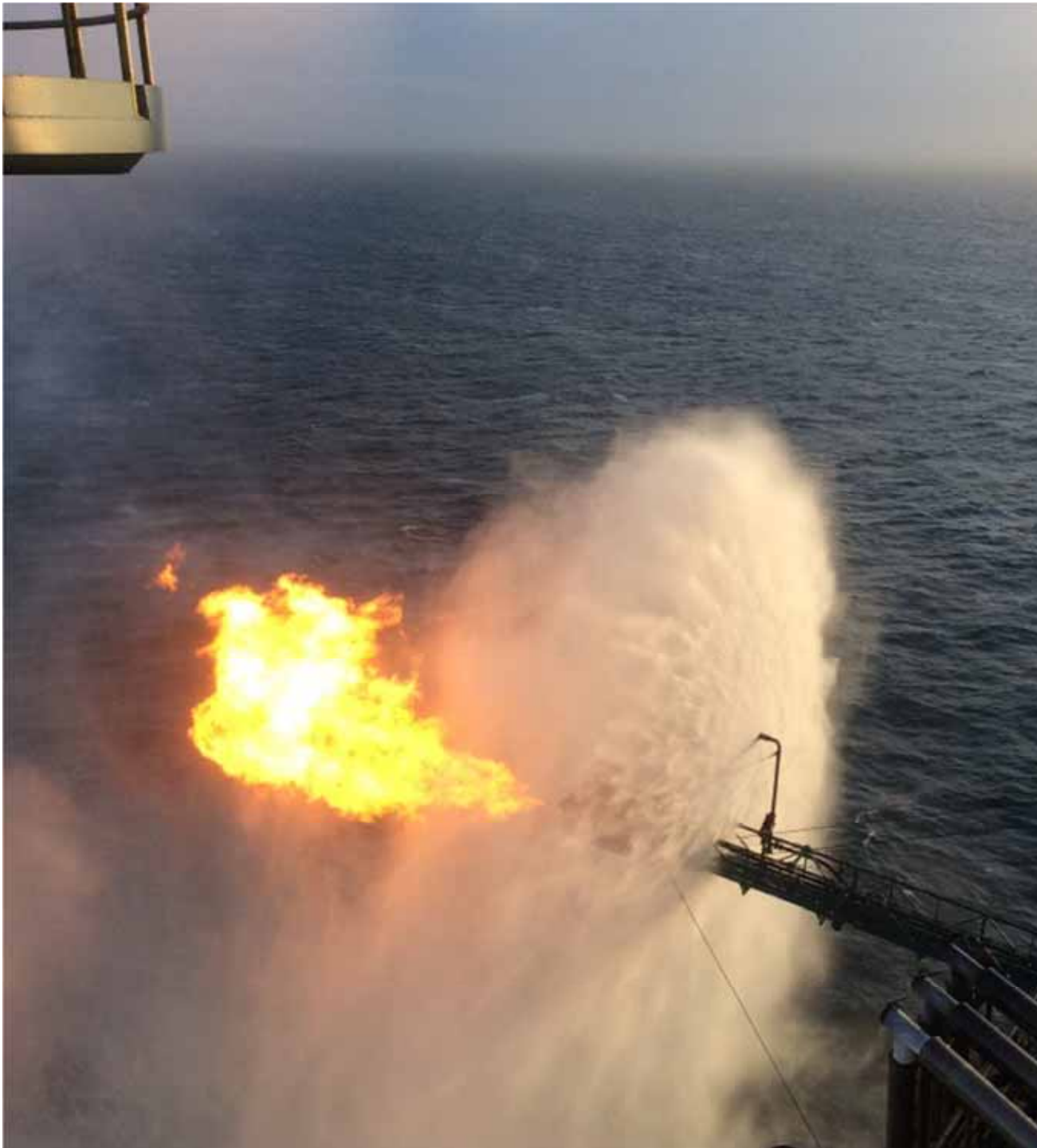
RigDeluge®

Engineered Safety Innovations

(Patented & Patents Pending)



Introducing Hazards & Risks by using Administrative Controls to allow it or use an Engineered Safety Innovation to Mitigate & Reduce Hazards and Risks?



RigDeluge® RD44®

- **Independently Certified**
- **Independently Certified Nozzle**
- **Independently Certified Performance**
- **No Crane Required**
- **No Nozzle Blockage**
- **No Blockage on Boom Walk Way**
- **Proven Patented Technology**
- **Transmissivity 90% ≥**
- **K-Factor 967.5**
- **Flow 890 usgpm**
- **Pressure 10-16Bar**
- **API 14G**
- **NFPA15**
- **ASME B31.3**
- **Diameter 36.5m**
- **Depth 6m**

Noted as the Safest and Most Efficient Flare Boom System in the World.

So unique it holds Global Patent Status

The RD44® & 6 Inch Free Flow Nozzle™

The primary barrier utilised during a well test operation it attenuates over 90% of the thermal radiation at source.

Fully independently certified by Bureau Veritas it complies with the following codes and standards making it the only flare boom system in the world to align with API14G

With a bench mark 120Ft Diameter profile as independently witnessed by BV it requires only 890usgpm @ 10 bar to achieve this ground breaking level of performance.

It will operate with pressures up to 16 bar and is tested to 32 bar during its design approvals, it is so unique it holds Global Patent Status and is known as the safest flare boom cooling system in the world.

RigDeluge® will work with our clients to allow for a purchase agreement or rental depending on their own bespoke requirements, we offer for sale all our safety innovations as they were designed to ensure the safety learnings and applications are provided to the industry as a whole.

REDUCE RISK AS FAR AS REASONABLEY PRACTICAL

Problem Encountered 001 of 010

Blocked Walk Way Mitigated by RD44®



RISK INTRODUCED HSE LAW BROKEN

Problem Encountered 001 of 010

001 Blocked Walk Way Mitigated by RD44®



RISK HAS BEEN REDUCED AS FAR AS REASONABLEY PRACTICAL

Problem Encountered 002 of 010

002 Crane Lift For Install Required Mitigated by RD44®



Two men working on a flare boom 1.1m wide over 100ft above open water with a crane lift over height.

Potential:

- Struck by Load
- Pinched Fingers
- Slip, Trip & Fall
- Drop Load
- Back Injury Crawling Under Boom Base Unit

All recorded previously

RISK INTRODUCED HSE LAW BROKEN

Problem Encountered 002 of 010

002 Crane Lift For Install Mitigated by RD44®



Installed On-Shore – Shipped Installed – Reduced Rig Up Time Off-Shore – Reduced Man Hours On Flare Boom

Problem Encountered 003 of 010

003 Crane Lift For Service & Maintenance Required Mitigated by RD44®



Blocked Nozzles & Crane Striking Recorded

Problem Encountered 003 of 010

003 Crane Lift For Service & Maintenance Required Mitigated by RD44®



One man operation to position either in the operational position or the stowed position.

360 Deg Vertical and Horizontal Movement

Problem Encountered 004 of 010

004 Lifting Cert / Pad Eye Mitigated by RD44®



It has been recorded that due to pad eye and sling certs being out of date that the boom system could not be removed from the flare boom.

This has recorded NPT and required high risk lifting operation on the flare boom to have it removed.

Mitigate this and reduce risk but also costs associated with re-certification on long term contracts reduces all round costs and risks with re-certification to be complete off-shore.

RISK INTRODUCED

Problem Encountered 004 of 010

004 Lifting Cert / Pad Eye Mitigated by RD44®



RISK HAS BEEN REDUCED AS FAR AS REASONABLEY PRACTICAL

Problem Encountered 005 of 010

005 Boom Swung In To Fit Boom System as rigs own crane cant reach when in the operating position
Mitigated by RD44®



Two men working on a flare boom 1.1m wide over 100ft above open water with a crane lift over height.

Also Boom Swung In To Rig Side as the Crane CAN NOT reach the position of deployment when in the outbound position.

Potential:

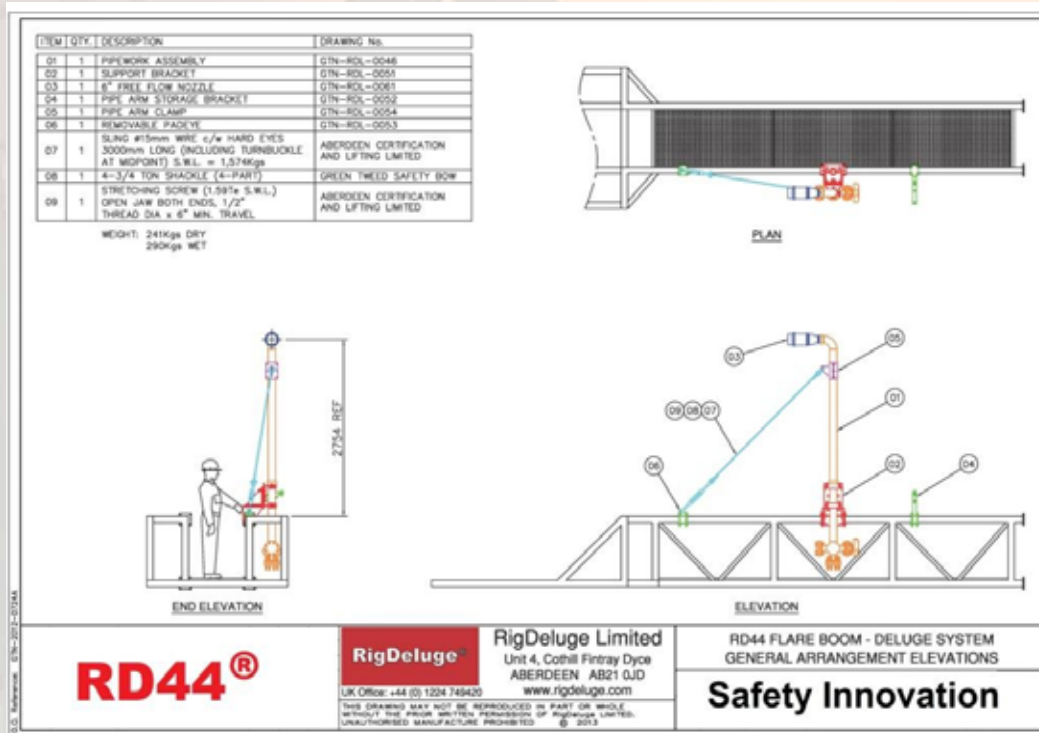
- Struck by Load
- Struck by Boom
- Pinched Fingers
- Slip, Trip & Fall
- Drop Load
- Back Injury Crawling Under Boom Base Unit

ADDITIONAL RISK INTRODUCED

All recorded previously

Problem Encountered 005 of 010

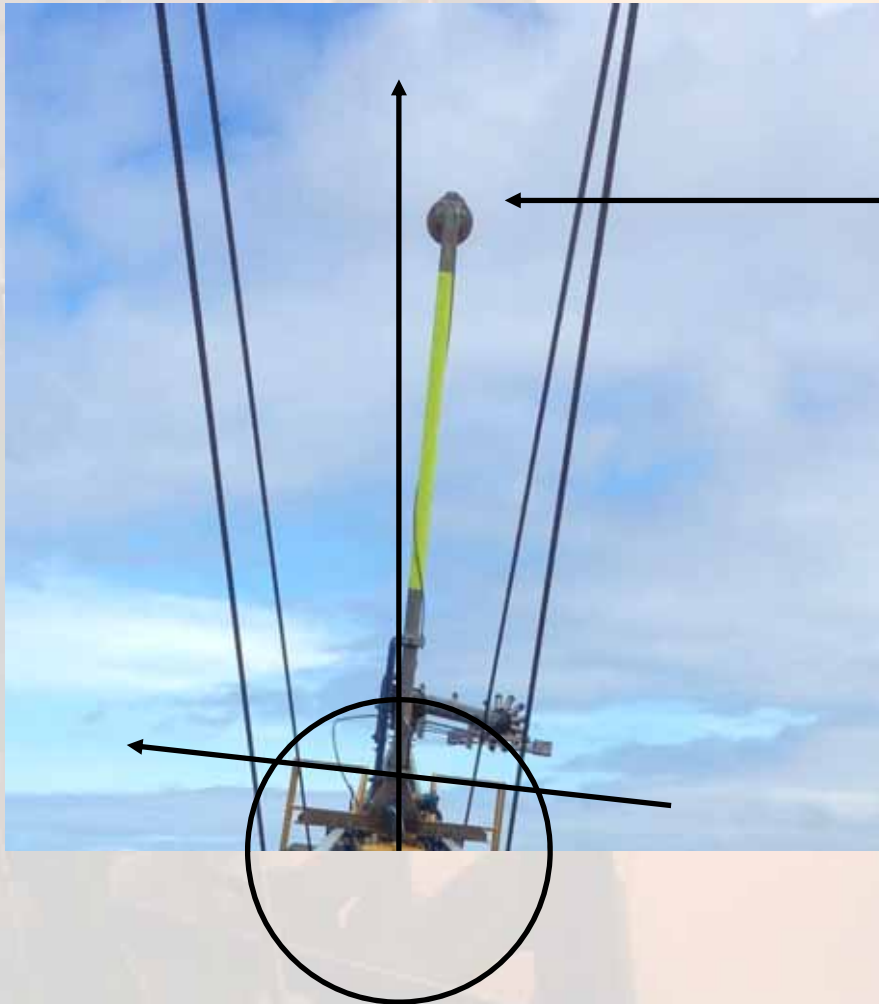
005 Boom Swung In To Fit Boom System as rigs own crane cant reach when in the operating position
Mitigated by RD44®



RISK HAS BEEN REDUCED AS FAR AS REASONABLEY PRACTICAL

Problem Encountered 006 of 010

006 Boom Twisting Mitigated by RD44®



The weight of the Nozzle on the Boom Stanchion can force the boom to twist under load.

The Higher the stanchion the greater the risk, due to high water required for performance 1500 usgpm @ 80ft Diameter this causes problems for higher flow rates.

The weather is un-predictable and the burner head its self was designed to be re-positioned and is used as designed.

A higher centre of gravity with the weight of the nozzle which will block creates the twisting of the boom which also puts additional forces on the sling sets of the flare boom.

An operator working on this boom will be off balance while doing his job.

Also noted are the jet forces with no sling to support.

006 Boom Twisting Mitigated by RD44®

[illegible][illegible][illegible][illegible]

BUREAU
VERITAS

BV Job No. 14ABD8354647

Page 2 of 2
Cert. No. 12ABD61946 Rev. B

GTN-RDL-0052 Rev. E
GTN-RDL-0053 Rev. D
GTN-RDL-0054 Rev. D
GTN-RDL-0051 Rev. E (Ref.)

Pipe Arm storage support Bracket
Removable Padeye
Pipe Arm Clamp
6" Free flow nozzle 12ABD61732 Rev. A

Manufacturing standards:

To be manufactured as per ASME B31.3 - 2012

Design references

ASME B31.3: 2012
ASME B16.5: 2013 (RFSSO Flange only)
ASME B16.9: 2012 (4" Equal Cross and 4" Elbow only)
API 14 G: 2007 (Nozzle only)
AISC Steel Construction Manual 14th edition
AISC Specification for Structural Steel Buildings: 2010

The above design has been reviewed against the specified design references. As a result, BUREAU VERITAS considers that equipment manufactured to this design will satisfy the specified performance criteria. Consequently, this certificate is considered to contribute towards a duty holder's obligation for the verification of the equipment's design under the requirements of the following regulations and / or associated guidance:

SI-2306 (1998) Provision and Use of Work Equipment Regulations (PUWER)
SI-2307 (1998) Lifting Operations and Lifting Equipment Regulations (LOLER)

Made at Aberdeen
19th March 2014

Engineer
Vijit Vishwanathan

Validated – Technical Engineer
And Senthil

Note: The above certificate is not valid until the Engineer and the Validator have signed the certificate

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IND1943 Rev

Problem Encountered 007 of 010

007 Crane Strike Mitigated by RD44®



Optima painted their Stanchions Yellow after it was struck by a crane.



RigDeluge® Mitigated this by allowing it to be stowed between well operations

Problem Encountered 008 of 010

008 Not Certified to FF Codes and Standards Mitigated by RD44®


BUREAU VERITAS

Page 1 of 2
BIV Job No. 14ABD0354647 Cert. No. 12ABD01946 Rev. B

INDEPENDENT REVIEW CERTIFICATE

Manufacturer: RigDeluge Limited

Description: RD44 FLARE BOOM DELUGE SYSTEM

Design Ref: GTN-RDL-0042 Rev. E (Ref.), GTN-RDL-0043 Rev. E (Ref.)

Performance criteria:

Maximum System working pressure	285 psig (piping)
Estimated Maximum Flow Rate	1000 gpm (piping)
Service Temperature Range	-10°C to +280°C
Maximum Nozzle Reaction	3750 N
SWL (Sling Wire)	1440 kg

Materials:

(1) St. St. 304 (Primary steel)	Yield: > 205 MPa, Tensile: > 515 MPa
(2) SS3092 Gr. B.8 (Bolt)	Yield: > 640 MPa, Tensile: > 800 MPa
(3) EN10025-2 (S275J2) (Plate)	Yield: > 235 MPa, Tensile: > 360 MPa

Note:

- Material charge impact values to comply with ASME B31.3 - 2012 standard at -10°C
- Dimensions of 4" 90° LR Elbow to be as per Table 1 ASME B16.9 - 2012
- Dimensions of 4" Class 150 RFSS Flange to be as per Table 7 & 8 ASME B16.5 - 2012
- Dimensions of 4" 90° Equal Cross to be as per Table 7 ASME B16.8 - 2012
- Sling angle to be 45 degrees to vertical
- Only the RD44 Flare Boom Deluge System has been included in the analysis

Drawings and design data:

Documents/Drawings No.	Description
GTN-RDL-0042 Rev. E (Ref.)	General Arrangement - Isometric
GTN-RDL-0043 Rev. E (Ref.)	General Arrangement - Elevations
GTN-RDL-0048 Rev. E	Pipework Assembly
GTN-RDL-0051 Rev. E (Sht 1 to 2)	Support Bracket Assembly
GTN-RDL-0051 Rev. E (Sht 3)	Pipework Clamp Plate
GTN-RDL-0051 Rev. E (Sht 4)	Upper Weldment
GTN-RDL-0051 Rev. E (Sht 5)	Lower Weldment
GTN-RDL-0051 Rev. E (Sht 6)	Clamp Plate
GTN-RDL-0051 Rev. E (Sht 7)	Washer Upper/Pipework Clamp
GTN-RDL-0051 Rev. E (Sht 8)	Washer Upper
GTN-RDL-0051 Rev. E (Sht 9)	Washer Lower
GTN-RDL-0051 Rev. E (Sht 10)	Axle Pin & Lock Nut Details
GTN-RDL-0051 Rev. E (Sht 11)	Idle Bushing - 26 Long

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RD1943 Rev.1


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Page 2 of 2
BIV Job No. 14ABD0354647 Cert. No. 12ABD01946 Rev. B

GTN-RDL-0052 Rev. E Pipe Arm storage support Bracket
GTN-RDL-0053 Rev. D Removable Plate
GTN-RDL-0054 Rev. D Pipe Arm Clamp
GTN-RDL-0051 Rev. E (Ref.) 6" Free flow nozzle 12ABD01132 Rev. A

Manufacturing standards: To be manufactured as per ASME B31.3 - 2012

Design references:

- ASME B31.3 - 2012
- ASME B16.5 - 2013 (RFSS Flange only)
- ASME B16.9 - 2012 (4" Equal Cross and 4" Elbow only)
- API 14.3 - 2007 (Nozzle only)
- AISC Steel Construction Manual 14th edition
- AISC Specification for Structural Steel Buildings: 2010

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- SI-2305 (1996) Provision and Use of Work Equipment Regulations (PUWER)
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Made at Aberdeen
19th March 2014

Engineer: Waji Vithanathan
Validator - Technical Engineer: Anil Senidil

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RD1943 Rev.1



Both the performance and engineering of this system has been independently witnessed and certified in line with industry codes and standards. So Unique it has now GLOBAL patent status even noted in CHINA where it is very hard to achieve this level of protection.



RigDeluge® FFNT™

- **Independently Certified Nozzle**
- **Independently Certified Performance**
- **No Nozzle Blockage**
- **Proven Patented Technology**
- **Transmissivity $\geq 90\%$**
- **1.0" K-Factor 140**
- **Flow 148 usgpm**
- **Pressure 10-16Bar**
- **API 14G**
- **NFPA15**
- **ASME B31.3**
- **Diameter 6m**
- **Depth 12m**

- **0.5" K-Factor 75.9**
- **Flow 63 usgpm**
- **Pressure 10-16Bar**
- **API 14G**
- **NFPA15**
- **ASME B31.3**
- **Diameter 4.2m**
- **Depth 4.3m**

Patented Technology

The Free Flow Nozzle™

The secondary barrier utilised during a well test operation it attenuates over 90% of the thermal radiation.

Fully independently certified by Bureau Veritas it complies with the following codes and standards including API14G

With a low volume requirement of 240LPM (63 USGPM) for the 0.5" @ 10 bar or 560LPM (148USPM) to achieve more than 90% thermal attenuation with a larger profile than any other nozzle in the world.

Its unique forward angle also ensure that there is a reduced risk of water on the deck during well test operations. This reduces both the risk to personnel and equipment on deck from the salt water spray back from the system.

This is the worlds first sprinkler head capable of operating where small quatrain of delivery line contamination is present, this ensure no None Productive Time recorded through the cooling system failing through blocked nozzles and the well test having to be shut down to have them cleaned.

A simple fixed system up-grade will allow a failing system be retrofitted to an operational one by simply replacing the sprinkler heads.

Patented Technology again setting a new standard in the Oil and Gas Industry.

Problem Encountered 009 of 10

Blocked Boom Nozzle with No API14G Cert Mitigated by FFNT™



Blocked sprinkler heads are very common and will create NPT, they also risk harm to personnel and the asset where it only takes 2000btu to blister human skin in 20s

Noted: In-Line Filters do NOT work.

Problem Encountered 009 of 10

Blocked Boom Nozzle with No API14G Cert Mitigated by FFNT™



Constant Transmissivity / Protection with no nozzle ever being recorded to block on a rig cooling project or actual fire protection system. Patented technology born through the failings of deluge nozzles as noted on the Piper Alpha.

010 Nozzle Not Certified to FF Code or Standard Mitigated by RD44® & 6" FFN

 BUREAU VERITAS		Page 1 of 2 Cert. No. 12AB01753 Rev. A																											
(V) Job No. 14AB0154006																													
INDENPENDENT REVIEW CERTIFICATE																													
Manufacturer:	HighDeluge Ltd Unit 2, Roak Road, Preshall, Abbeville, AB32 6TJ																												
Description:	8" Free Flow nozzle technology - Fabricated general arrangement (Option 1 & 2)																												
Design Ref:	GTM-RCL-0061 Rev. E (RCL 4.2-4719)																												
Performance criteria:	Maximum design working pressure: 18 bar Design working pressure range: 1 - 18 bar Design test pressure: 30 bar Service temperature range: -19°C to +100°C Service: Standard (see note)																												
Materials:	(1) ST. 304 Yield > 210 MPa; Tensile > 520 MPa (3) 30403																												
Note:	1. Material subject impact values to comply with ASME B31.3 - 2012 standard at -19°C. 2. Dimensions of 8" x 4" Conn. Reducer to be as per Table 1-11 ASME B16.9 - 2012. 3. Dimensions of 4" Class 1500 RFSSO Flange to be as per Table 7 & 8 ASME B16.5 - 2012																												
Drawings and design data:	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;">Drawing No.</th> <th style="width: 40%;">Description</th> <th style="width: 20%;">Material Type</th> </tr> </thead> <tbody> <tr> <td>GTM-RCL-0061 09H1 Rev E</td> <td>Nozzle assembly Option 1</td> <td>NA</td> </tr> <tr> <td>GTM-RCL-0061 09H2 Rev E</td> <td>Nozzle assembly Option 2</td> <td>NA</td> </tr> <tr> <td>GTM-RCL-0062 09H1 Rev E</td> <td>Inner Body-Reduction Option 1</td> <td>(1)</td> </tr> <tr> <td>GTM-RCL-0062 09H2 Rev E</td> <td>Inner Body-Reduction Option 2</td> <td>(1)</td> </tr> <tr> <td>GTM-RCL-0063 09H1 Rev E</td> <td>Inner Body-Machining Option 1</td> <td>(1)</td> </tr> <tr> <td>GTM-RCL-0063 09H2 Rev E</td> <td>Inner Body-Machining Option 2</td> <td>(1)</td> </tr> <tr> <td>GTM-RCL-0064 Rev E</td> <td>Outer body</td> <td>(1)</td> </tr> <tr> <td>GTM-RCL-0065 Rev E</td> <td>Outlet Catcher</td> <td>(1)</td> </tr> </tbody> </table>	Drawing No.	Description	Material Type	GTM-RCL-0061 09H1 Rev E	Nozzle assembly Option 1	NA	GTM-RCL-0061 09H2 Rev E	Nozzle assembly Option 2	NA	GTM-RCL-0062 09H1 Rev E	Inner Body-Reduction Option 1	(1)	GTM-RCL-0062 09H2 Rev E	Inner Body-Reduction Option 2	(1)	GTM-RCL-0063 09H1 Rev E	Inner Body-Machining Option 1	(1)	GTM-RCL-0063 09H2 Rev E	Inner Body-Machining Option 2	(1)	GTM-RCL-0064 Rev E	Outer body	(1)	GTM-RCL-0065 Rev E	Outlet Catcher	(1)	
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 BUREAU VERITAS	Page 2 of 2 Cert. No. 12AB01732 Rev. A
IDV Job No. 14AB0250400E	
<p><i>Scope of the contract:</i> This design review only covers the mechanical integrity of "F" Free Flow nozzles to the above mentioned design criteria. Installation and operational criteria should comply to API 14C and has to be proven by testing.</p>	
<p>The above design has been reviewed against the specified design references. As a result, BUREAU VERITAS considers that equipment manufactured to the design will satisfy the specified performance criteria. Consequently, this certificate is limited to contribute towards a duty holder's obligation for the verification of the equipment's design under the requirements of the following regulations and / or associated guidance:</p>	
SI-913 (1996) Offshore Installations and Wells, Design and Construction Regulations SI-2306 (1996) Provision and Use of Work Equipment Regulations (PUWER)	Violator And Santhi
Date 16 th February 2014	Engineer Vijit Vinayachandran
	
	
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RigDeluge® Training

With over 20 years rig cooling / heat suppression experience on both fixed systems and rentals we are able to ensure all problems encountered and lessons learned over this period are passed to the staff members of our clients. Communication is everything when it comes to safety and our teams have the ability to not only do the job but share their experience with those who wish to learn.

Competency and Safety go hand in hand when dealing with any type of fire fighting / suppression systems and we pride our self in being the world leaders in this technology for both Planned Fires and Un-Planned Fires in the Oil and Gas Industry.



Sharing Safety Learnings



Un-Planned Fire Protection



Un-Planned Fire Protection

The RigDeluge® CFT™ Adaptor is leading the industry and the fire fighting world in anti-nozzle blocking technology. During a Well-Test these risks are increased all around the drill ship and on the platform if on a work over. A simple retrofit we can ensure your system wont fail through blocked nozzles when it is required to operate on demand during an un-planned fire.

As you never get a second chance with a fire these systems need to operate first time every time and from the drill floor to the Heli-Deck in the event of a fire on any oil rig the safety critical system that protects the safety critical equipment and escape routes is more important than ever.

- Life Boats
- Life Rafts
- Heli-Deck (Fuel)
- Drill Floor
- Well Bay



SOLUTION



PROBLEM





Blocked Nozzle
System Failure



Remove & Clean
Blocked Nozzle



Install RigDeluge® CFT™ Adaptor

**RISK HAS BEEN
REDUCED AS FAR AS
REASONABLEY
PRACTICAL**











A member of the
**BRITISH
SAFETY
COUNCIL**



www.RigDeluge.com