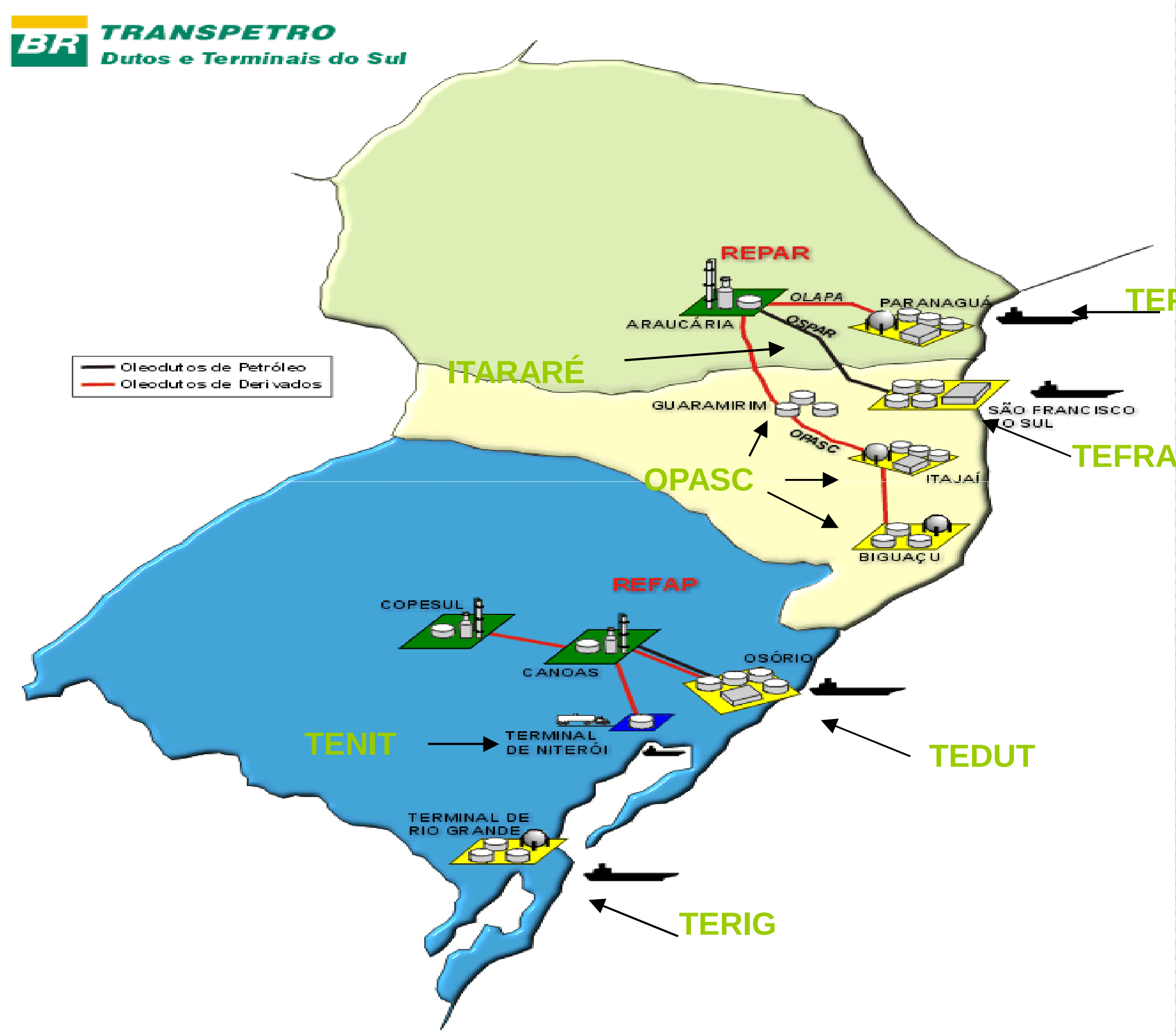
Using MBC Valves in offshore marine terminals



Using MBC Valves in offshore marine terminals

Breakaway – To use it or not to use it – that is the question !!!

Using MBC Valves in offshore marine terminals

TRANSPETRO

- TEFRAN - São Francisco do Sul

SBM II **- SO 1007** (Crude oil)

- **TEDUT - Tramandaí**

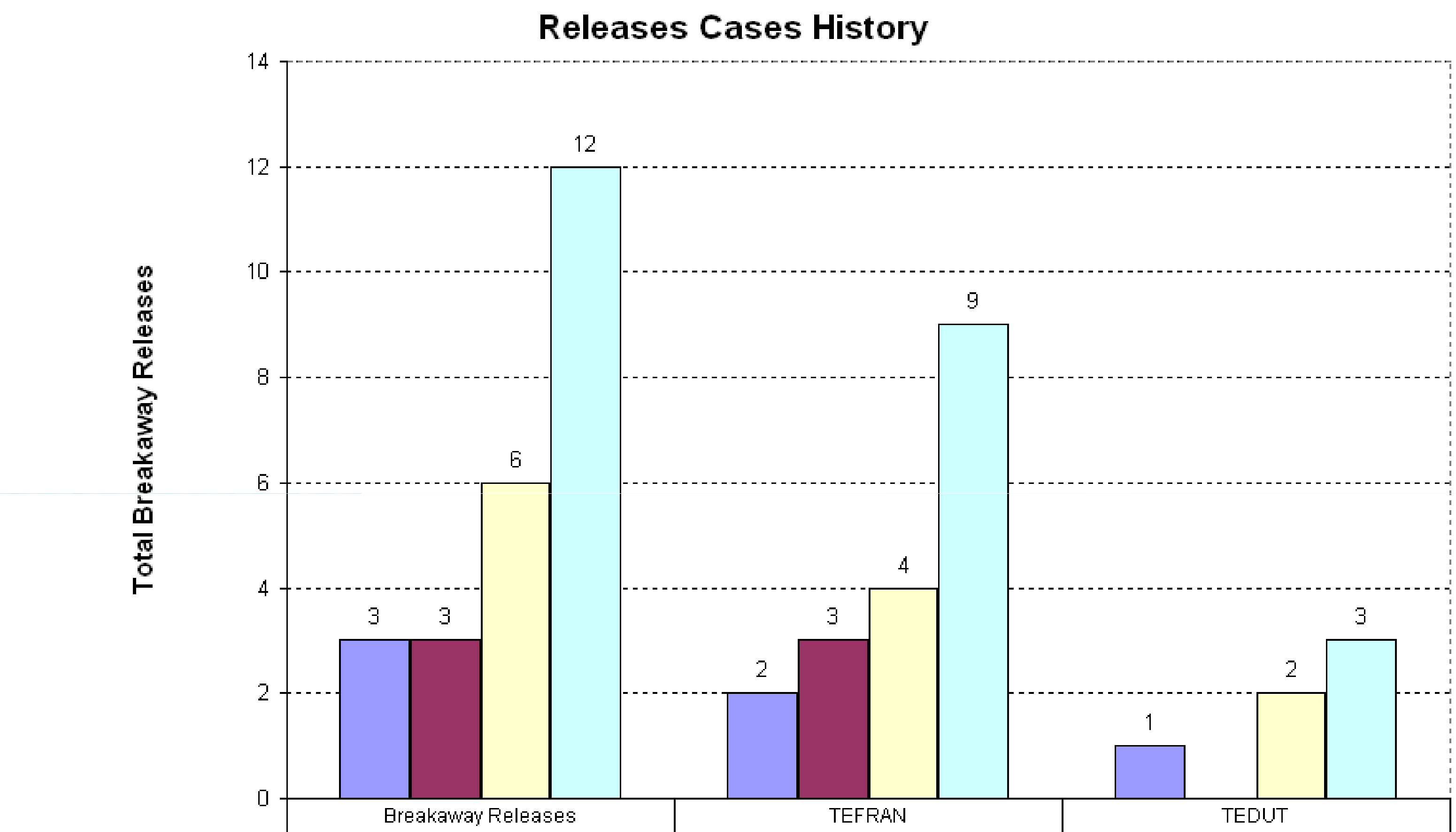
SBM 3 **- Oil products** (Diesel, Naphtha)

IMODCO II **- SO 1153** (Overhauling)

SBM III **- SO 1111** (Crude oil)

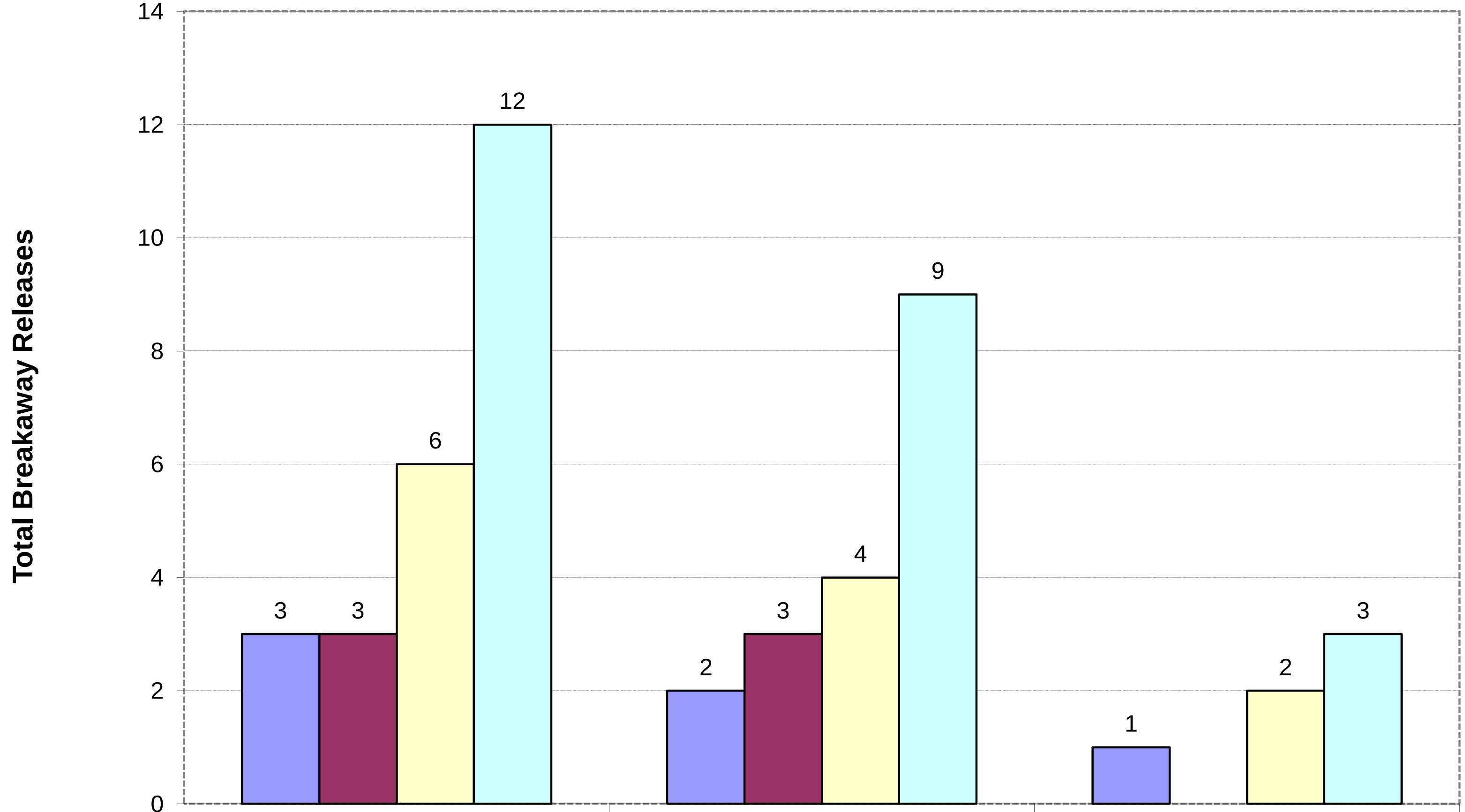
The Monobuoys started in operation by the years 70's and 80's.

Using MBC Valves in offshore marine terminals



	Breakaway Releases	TEFRAN	TEDUT
Releases properly	3	2	1
Preventive inspection	3	3	
Corrective maintenance	6	4	2
Total Breakaway Releases	12	9	3

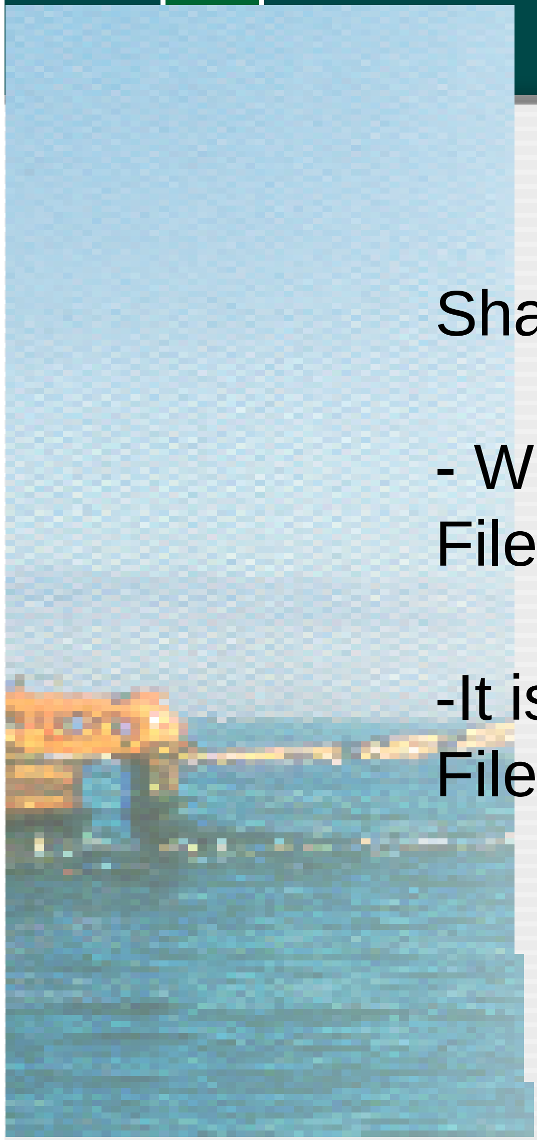
Releases Cases History



	Breakaway Releases	TEFRAN	TEDUT
Releases properly	3	2	1
Preventive inspection	3	3	
Corrective maintenance	6	4	2
Total Breakaway Releases	12	9	3

	Breakaway Relea	TEFRAN	TEDUT
Releases properly	3	2	1
Preventive inspection	3	3	
Corrective maintenance	6	4	2
Total Breakaway Releases	12	9	3

Using MBC Valves in offshore marine terminals



Sharing information

- Why 35 tonnes breakstud load?
File→35 tonnes Bridgestone reference.pdf

-It is possible to increase breakstud load?
File→MIB reference increase breakstud load.doc

{Em arquivamento} Enc: Bridgestone Marine Hoses / Traction Force

Marcus Antonius Soares
TRANSPETRO/PRES/SE/ENG/STSU
L

14/02/2012 11:42
Corporativo

para: Sinval Miguens de Araujo

Arquivar: Esta mensagem está sendo vista em um arquivamento.

Repassando !

----- Repassado por Marcus Antonius Soares/BRA/Petrobras em 14/02/2012 11:41 -----

De:	Marcus Antonius Soares/BRA/Petrobras
Para:	Roberto Najar Bazolli/BRA/Petrobras@PETROBRAS, Allyson Forny Sena/BRA/Petrobras@Petrobras, Raphael Reguine Ribeiro/BRA/Petrobras@Petrobras, Isaias Quaresma Masetti/BRA/Petrobras@Petrobras, Ronaldo Luiz dos Santos/BRA/Petrobras@Petrobras
Cc:	Ronaldo Romeu Costa/BRA/Petrobras@Petrobras, Anibal Augusto Fernandes Junior/RJ/Petrobras@Petrobras, Luiz Renato Castro Segui/BRA/Petrobras@PETROBRAS
Data:	02/02/2012 17:28
Assunto:	Enc: Bridgestone Marine Hoses / Traction Force

Pessoal , para compartilhar conhecimento ! Nunca tinha encontrado uma explicação para as 35 ton de carga de ruptura, agora está explicado.Hoje utilizamos mangotes de dupla carcaça, e atualmente a premissa maior é o meio ambiente e não a salvaguarda da linha de mangotes, foi por este motivo que solicitamos o aumento da carga de 35 para 40 ton.

A última nota anexa da Bridgestone é a que interessa.

Atenciosamente,

Marcus Antonius Soares
GERENTE DE SUPORTE TÉCNICO DE DUTOS E TERMINAIS DO SUL
R.Felipe Musse, 803 Ubatuba
CEP - 89.242-000 São Francisco do Sul - SC
Tel.: 47-3471 5403 Fax.: 47- 3471 5160
Rota.: 856 5403 Cel.: 47 - 9964 0942
Chave pessoal: tf76 - Chave estrutural - trh1
email:marcus@petrobras.com.br
----- Repassado por Marcus Antonius Soares/BRA/Petrobras em 02/02/2012 17:21 -----

{Em arquivamento} Bridgestone Marine Hoses / Traction Force

Marcus Antonius Soares
TRANSPETRO/PRES/SE/ENG/STSU
L

31/03/2011 09:21
Corporativo

para: Marcelo Hessel de Castilho, Cesar Rezende Silva

De: Marcus Antonius Soares/BRA/Petrobras

Para: Marcelo Hessel de Castilho/BRA/Petrobras, Cesar Rezende Silva/BRA/Petrobras

Arquivar: Esta mensagem está sendo vista em um arquivamento.

Meninos desencavei uma boa dica, vejam abaixo !

sds,
Marcus
----- Repassado por Marcus Antonius Soares/BRA/Petrobras em 31/03/2011 09:20 -----

{Em arquivamento} Bridgestone Marine Hoses / Traction Force

Marcus Antonius Soares
TRANSPETRO/PRES/SE/ENG/STSUL

para: RICARDO IZQUIERDO, 'Boam Guillermo', 'jose perdomo r.', 'Fabiàn Sànchez', Alfredo Sabatin, jorge castiblanco, Jose Becerra, oscar.garcia, S Samaniego, William Santana

29/03/2011 17:26
Corporativo

Cc: Luiz Vicente Maurer Ferreira da Costa, Waldo Gomes dos Santos, Rodrigo Magrini Antunes, Cesar Rezende Silva, Luis Henrique Dall Agnol Alves, Pedro Paulo Becker, Ronaldo Luiz dos Santos, Luciano Maldonado Garcia, Luiz Felipe Affonso Rolo, Raphael Reguine Ribeiro, Claudio Roberto Alcalde, Marcelo Hessel de Castilho, Cesar Rezende Silva, Sergio Zeitone Pimentel, Luiz Vicente Auler Passos Miranda, Luciano Maldonado Garcia

Arquivar: Esta mensagem está sendo vista em um arquivamento.

Prezados Amigos,

A minha memória está sentido o pêso da idade, contudo eu tinha certeza que já tinha lido em catálogos ou alguma outra fonte a origem do limite de 35 ton para a carga de ruptura dos elementos fusíveis dos nossos breakaway couplings. Finalmente pesquisando meus arquivos, encontrei uma nota de Dez/2002 da Bridgestone que resolvi compartilhar com vocês. Assim deixo abaixo a nota para o conhecimento e divulgação.

Notem que com o desenvolvimento da tecnologia e a adoção de mangotes de dupla carcaça é possível assumir valores maiores do que as 35 ton limitadas pelo mangotes de 16" polegadas, é só uma questão de solicitar-mos dos fabricantes a Maximum Allowable Working Traction Force para os mangotes atualmente fabricados.

saudações,
Marcus

PORTUÑOL

Estimados Amigos,

Mi memoria siente el peso de la edad, pero yo estaba seguro de que había leído en los libros o alguna otra fuente la origen del límite de 35 toneladas para la carga de rotura de los elementos fusibles de nuestros breakaway couplings. Por último pesqusando mío archivo, encontré una nota de Dic/2002 de la Bridgestone, decidí compartir con ustedes. Así sigue la nota para el conocimiento y difusión.

Tengan en cuenta que con el desarrollo, adopción de nuevas tecnologías y de mangueras de doble carcassa si puede asumir valores superiores a los limitados por las mangueras de 35 toneladas de 16 "pulgadas, es sólo una cuestión de que solicitemos de los fabricantes que informen la *"Maximum Allowable Working Traction Force"* de las mangueras que fabrican.

Saludos,

Marcus Soares

----- Repassado por Jarbas Oliveira Bueno/SP/Petrobras em 23/12/2002 09:48 -----

"Lobo,JonasRIOMH" <jlobo@rio.mitsui.com>
20/12/2002 18:58

Para: "'jarbas@petrobras.com.br'" <jarbas@petrobras.com.br>
cc: riomh <riomh@rio.mitsui.com>
Assunto: ENC: Re[2]: Bridgestone Marine Hoses / Traction Force

FYR
-----Mensagem original-----
De: Juan C. Guarin [mailto:guarin@bep-usa.com]
Enviada em: sexta-feira, 20 de dezembro de 2002 17:14
Para: Lobo,JonasRIOMH
Cc: Leite,RogerioRIOMH
Assunto: FW: Re[2]: Bridgestone Marine Hoses / Traction Force

Jonas,

Please see revised figures below, please pass to Mr. Jarbas. tks!

Regards,

Juan Carlos Guarin

Bridgestone Industrial Products America, Inc.
Houston Office
http://www.bridgestoneindustrial.com/

-----Original Message-----
From: shHiew [mailto:eh_hiew@bridgestone.com.my]
Sent: Thursday, December 19, 2002 7:04 PM
To: guarin@bep-usa.com; fujiwa-t@bridgestone.co.jp
Cc: kumaga-y@bridgestone.co.jp; eh_way@bridgestone.com.my;
yamamoto@bridgestone.com.my; eh_lee@bridgestone.com.my;
t-matsuura@bs-tokyo.co.jp; t-sakaga@bs-tokyo.co.jp;
h-watanabe@bs-tokyo.co.jp
Subject: Re: Re[2]: Bridgestone Marine Hoses / Traction Force

Dear Guarin,

The reply shall be as below:

aa) Maximum Burst Traction Force
16" = 119 ton
20" = 180ton

bb) Maximum Allowable Working Traction Force
16" = 35 ton
20" = 53 ton

As we follow OCIMF standard, the pressure should not exceed the Pressure Rating (which, including Surge Pressure). If there would be activation of Breakway Coupling, that would be considered as Emergency Case or Accident. It is adviced that if the Breakaway Coupling is Activated, full scale inspection is to be carried out confirming the hose performance.

Thank you.

Regards,
Hiew

MIB INTERNATIONAL LIMITED
MINUTES OF MEETING

CLIENT :	**TRANSPETRO**
PROJECT:	**TEFRAN & TEDUT**
LOCATION :	**São Francisco do Sul**
DATES OF MEETING :	**15th December 2003 – 16th December 2003 – 17th December 2003**
MEETING ATTENDEES:	Marco Soares – TEFRAN Luis Vicente Costa – TEFRAN Luis Roberto Garcia – TEFRAN Luis Henrique dall'Agnol – TEFRAN Ronaldo dos Santos – TEFRAN Jarbas Bueno – TEDUT Claudio Alcaldi – TEDUT Carlos Frederico A. de Albuquerque – CENPES Luis Volnei Sudati Sagrilo – UFRJ Luiz Vicente Auler Miranda - PETROBRAS Neil Cookson - MIBINT Roberto Kröss – MIBITA

Minute Number	Minutes	Action Date	Action By
	INTRODUCTION PETROBRAS purchased from MIB two 16" FB ANSI 150 Double Closure Hose breakaway units. These units were destined to two different sites: one was sent to the Terminal in São Francisco do Sul – TEFRAN, in the State of Santa Catarina (SC), the other to the Terminal in Tramandaì – TEDUT, in the State of Rio Grande do Sul (RS). The first unit installed was the one for TEFRAN, but after 23 unloading operations, during a routine check, on 20th October 2003, two bolts in titanium were found broken and another two had loosened. The unit was immediately removed from the hose string and the line was put out of service.		
1.0	***The first meeting.*** The arrival was in the afternoon of 15th December 2003 and after compliments, the representatives of TEFRAN, noted that the new Brazilian legislation is very strict and as a consequence, there is a real risk, in the case of a further accident with leakage of crude oil, that the terminal may be closed down.	15.12.03	

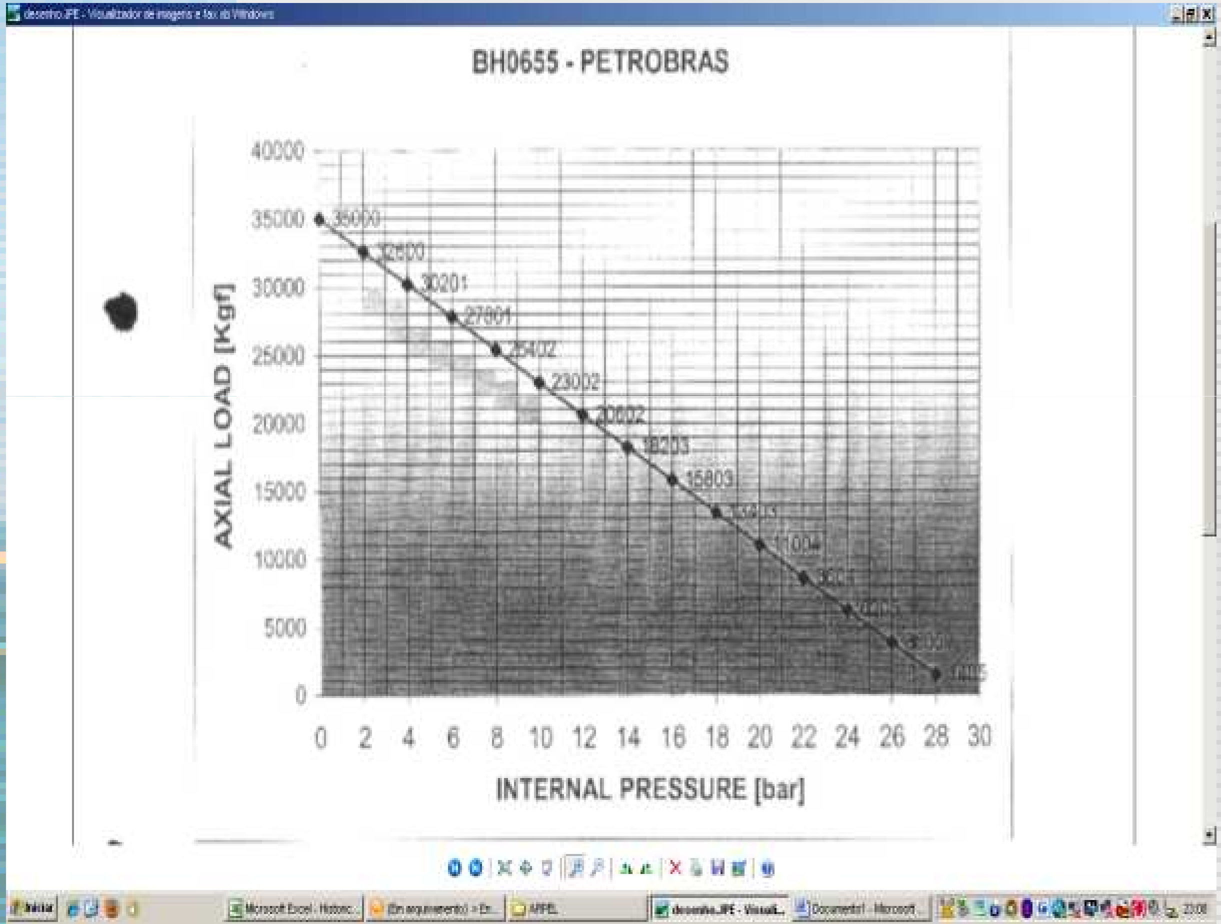
2.0	***The visit to the CALM site*** The following morning, before the meeting, the representatives of MIB and TEFRAN reached the buoy, and at that moment in time the tanker named “Piquete” was in the final unloading stage. Only one flexible hose line was in service, the second one had been removed for testing and installation of a Gall Thomson Unit HBU. The HBU on the line in question, from Gall Thomson, was in curved section of the string. Even if this is not the most suitable position for the high bending moments on the floating plane, TEFRAN explained that it was not possible to do otherwise because they have to take into account an optimum configuration that can satisfy all the tankers: the “Piquete” tanker is one of the smallest to moor on the CALM.	16.12.03	
2.1	The mooring line between the tanker and buoy is 80metres long. The two flexible hose lines, North and South, are composed respectively of 29 and 28 flexible hoses having a total length of 273 and 263metres. For both lines the first five flexible hoses, starting from the tanker’s manifold, are 16” and the subsequent ones up to the buoy are 20”. The position of the HBU’s is between the fifth and sixth flexible hose with a 16”-20” adaptation spool-piece downstream of the HBU.		
3.0	***The second meeting*** At the second meeting, there were the representatives of MIB, TEFRAN, TEDUT, CENPES, UFRJ and PETROBRAS. After a brief summary of the events, TEFRAN explained that up to 1991 there had never been any problems, from that date onwards there were three disconnections with Gall Thomson’s HBU and no tanker had ever broken the mooring or pulled the flexible hose line. It was then said that at the TEDUT terminal, where the installation is practically identical to TEFRAN, similar events had never occurred. Furthermore, It was added that the start of the problems, in 1991, coincided with the putting into service of flexible hoses with a double carcass configuration. A discussion then followed between TEFRAN and TEDUT in order to analyse the differences in the configurations between the two Terminals without reaching anything really significant. The only noteworthy thing is the presence at TEFRAN of a sling rope which constrains the strings to the tanker to prevent it from ending up under the bulb of the bow of the same. This constraint seems to accentuate the curvature of the line’s bend on the tanker’s port side towards the stern, before positioning itself towards the buoy. However that may be, there are situations in which the bend accentuates itself without any action by this sling rope. In addition it would appear that , at TEDUT, the sea conditions are slightly worse than those at TEFRAN. It was also confirmed that the MIB unit at TEDUT was never installed therefore it is impossible to compare the performances.		

	At the proposing of the photographs taken during installation, MIB observed that the assembly took place on the launching ramp without removing the floating collars, even if it is recommended that the unit should not rest against the same so as not to damage them. TEFRAN replied that the floating collars had not undergone any damage and that it appeared very difficult to install them at a later stage. In fact to drag the line without the floating collars into the water, would cause the HBU to run around immediately making the operation impossible. It was seen that during the installation a high level curvature was imposed on the flexible hose immediately above the HBU which, however, can be considered inferior to that normally found in the line under operation. From the photographs there is nothing that can be seen as being able to have induced an overload such as to justify the breaking of the bolts. In fact during the 23 routine inspections, before each tanker unloading, no bolts were found broken. It was decided, at MIB's suggestion, to foresee for future equipment manufacture, the insertion of additional bolts for installation (similar to the storm bolts for Vanguard) to avoid stressing the bolts in titanium during installation before putting unit into service. TEFRAN said confirmed that they had a lot of difficulty in flanging the second flexible 20" hose to MIB's unit since it was supplied with studded terminations. In addition, the studs supplied by MIB Italiana, in carbon steel with Teflon coating were replaced by TEFRAN with other stainless steel. MIB underlined that this solution is not recommended because it causes galvanic couples which could compromise the carbon steel female threads of MIB's terminations. TEFRAN commissioned CENPES to develop a simulation model, but their preliminary results in terms of load on the interface of the HBU are much lower than those calculated by MIB to cause the breaking of the first bolt. However they have not vast experience on the floating hoses and so they asked for MIB assistance in order to better simulate the flexible hoses. MIB would carry out an analysis parallel to that of CENPES in order to subsequently compare the results obtained. MIB will have to send a formal request directly to CENPES, after having consulted an external body which would carry out the analysis on behalf of MIB, for all the information required to complete the work. In addition, MIB will try, without obligation, to obtain information from the flexible hose suppliers that could be useful for their forming. MIB will also have to supply to CENPES a sketch with the dimensions of MIB unit, including the bolting circle diameter of the tie rods in titanium, and the relevant weights, since their results have been obtained from a model which takes into account the Gall Thomson unit. From the analysis of the position of the bolts which were found broken and loosened it was concluded that the overload which caused the damage is undoubtedly due to a bending moment in the floating plane (this would exclude the wave effect) caused by the curvature of the line.	16.12.03	CENPES MIB MIB MIB

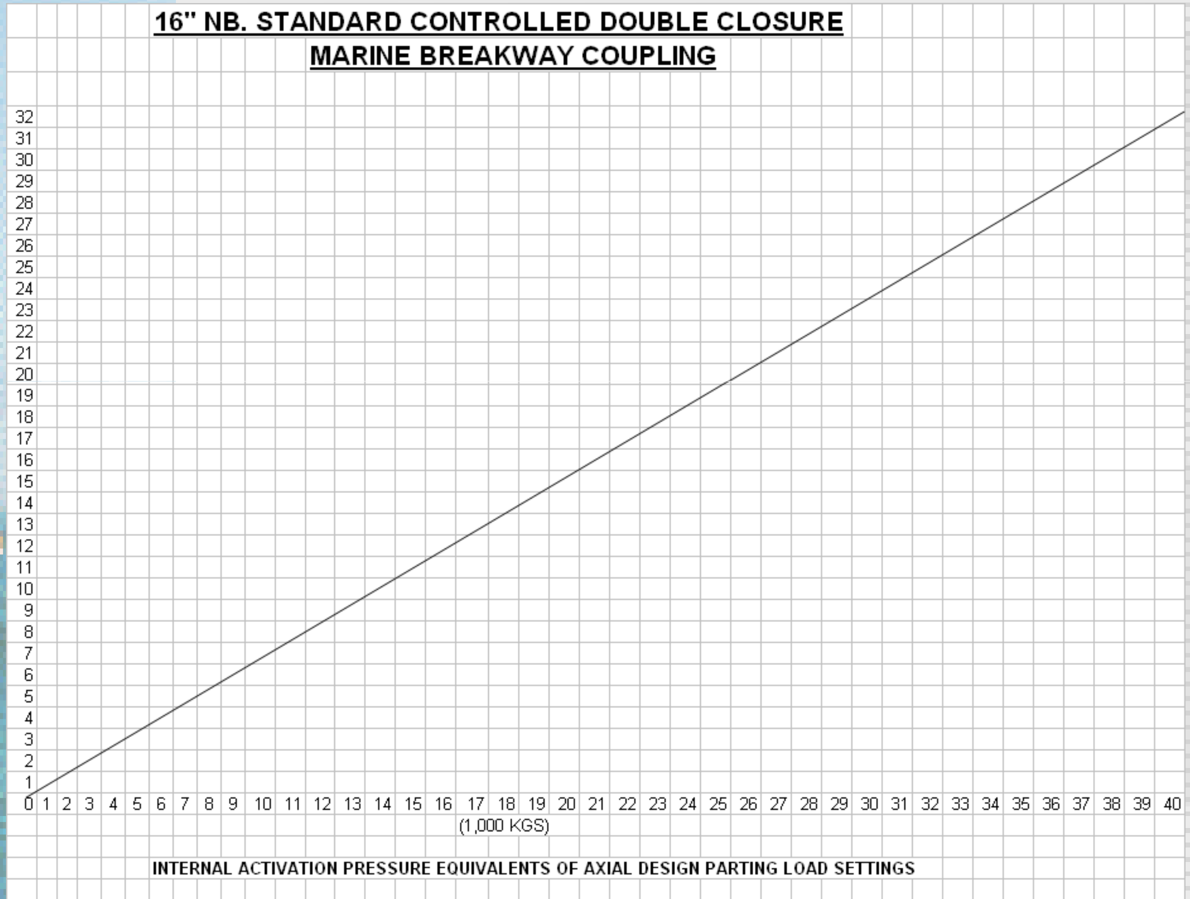
	In confirmation of the excessive bending moment there is substantiation of damage in the internal carcass of the flexible hose immediately downstream of the HBU. From the discussion that followed another consideration was highlighted with regard to the bending moment. During the mooring phase of the tanker, when the line is moved away by the tug-boat from the mooring area, and during the subsequent approach to the tanker's port side for connection to the manifold the line makes a "winding" movement with very tight curvatures. It is reasonable to think that this phenomenon, together with a choppy sea situation could be a possible cause of the breaking of the bolts: in fact it is easy to assume some splitting on the line. The representatives from the various departments debated on the real need of an HBU on the flexible hose string. The PLEM and the buoy are about to be replaced with components of a new design and safety factors have been further increased. It is sure, in their opinion that the failure of the tanker's mooring is an improbable event thus the HBU will never be required to work for an axial pull. In addition, considering that the Terminal receives from the tanker and that the valves on the mainland have high closure times, in the order of minutes, the release for overpressure can also be excluded. Nobody wanted to take the responsibility to remove HBU from the line. It was considered also the possibility of making the HBU less sensitive to the external loads: in fact the breaking load, specified as 35t, equivalent to 28.5bar of internal pressure, when compared to the normal burst pressures of the flexible hoses, normally over 100bar, appears very low an could possibly be increased. This statement is based on two considerations. The first considers that the HBU purpose is to avoid leakage of crude oil, that is to say that PETROBRAS could accept that the flexible hoses become damaged though without breaking themselves following an accident. The second one is referred to these two Terminals, TEFRAN and TEDUT, that is there will never be an overpressure on the line such as to require a separation: increasing the separation load implies the increase also of the equivalent pressure. TRANSPETRO did not agree upon bringing the HBU even more closer to the tanker because it is necessary to take into account the differences between the tankers that usually moor on the buoy. MIB will propose, if necessary, an alternative positioning. MIB pointed out that the 20" flexible hose, downstream of the HBU, requires the use of an adaptation spool-piece, which in its turn amplifies the effect imposed by the curvature of the flexible hose. It would be advisable to replace this flexible hose with a 16" one.		

	Disassembly of the unit In the afternoon of the same day, MIB inspected the equipment and the separation of the unit. The valves separated and closed without any difficulty. One of the two valves closed very quickly as we had to remove the closure control group, which has damaged when the unit was being taken out of the water. After the closure, one of the two spheres had its surface completely covered by a dirty black substance. Once the plugs had been removed, MIB rep. Discovered that the external chamber was full of crude oil: this indicates a leakage between the internal body and the central spool-piece at the level of the main "O" ring. The secondary one was swollen and seemed to have an internal diameter larger than its groove. TRANSPETRO recognized the cause of this in the incompatibility of the compound with the product. The causes of the leakage and bulging <u>must be verified</u>. MIB will carry out a fracture analysis of one of the two bolts found broken or anything else that could be helpful to understand what exactly happened.	16.12.03	MIB
4.0	***The third meeting*** In this last meeting MIB met the General Management of TEFRAN, who pointed out the gravity of what had happened, being qualified by them at a level of accident even if really a release had not actually occurred. They asked for clarification on the quantity of the product that would be introduced into the environment during closure of the spheres. TEFRAN believes that the time set of 15s is too high. They expect to receive from MIB a graph showing the quantity of crude oil dispersed in the environment depending on the closure time, flow rate and pressure for their evaluation. They specified the risky situation in which they found themselves against the current legislation.	17.12.03	MIB MIBINT

AXIAL LOAD X INTERNAL PRESSURE GRAP (MIB)



AXIAL LOAD X INTERNAL PRESSURE GRAP (GALL THOMSON)



PRIMARY CAUSE OF THE FAILURES

FATIGUE

File →Sociesc.pdf

File →Relatorio COPPE.pdf

Resultados das análises fractográficas:

- As figuras 27 a 34, mostram o aspecto das fraturas dos oito parafusos. Nota-se a trinca inicial, com "marcas de praia" características de fratura por fadiga, particularmente nos parafusos 4-3 e 3-2. Os parafusos ,com exceção dos parafusos 8-7 e 1-8, que romperam com aspecto característico de fratura dúctil por sobrecarga em tração, todos os demais apresentam trincas iniciais junto à concordância da seção reduzida do parafuso. Esta região apresenta concentração de tensões e é particularmente sujeita à nucleação e propagação de uma trinca de fadiga.

- O exame com maior aumento no MEV, revelou que a região de ruptura final dos 6 parafusos que fraturaram a partir de pré-trinca por fadiga – Fig. 35– apresenta alvéolos característicos de ruptura instável em material de alta tenacidade. Este mesmo aspecto foi observado – Fig. 36 - na região central da fratura por sobrecarga (taça-cone) dos parafusos 8-7 e 1-8.

- A região da fratura por fadiga apresenta vários amassamentos, que comumente ocorrem quando o ciclo de tensões provoca o fechamento das superfícies das trincas por fadiga. A observação de estrias de fadiga ficou particularmente prejudicada pelos amassamentos ocorridos. A Fig. 38 mostra uma pequena região com aspecto característico de estrias.

Avaliação da tensão de ruptura na presença de uma trinca de fadiga – BS7910:1999 Amendment 2000:

A BS 7910:1999 Amendment 2000, fornece as equações para determinação do tamanho crítico de uma trinca com profundidade **a**, de frente reta, numa barra cilíndrica de raio **r**, sujeita a uma tensão axial **S**, no Anexo M (normativo) parágrafo M.6.1., a saber:

$$K_{IC} = M_m * S * (\pi * a) \wedge 0{,}5$$

Onde:

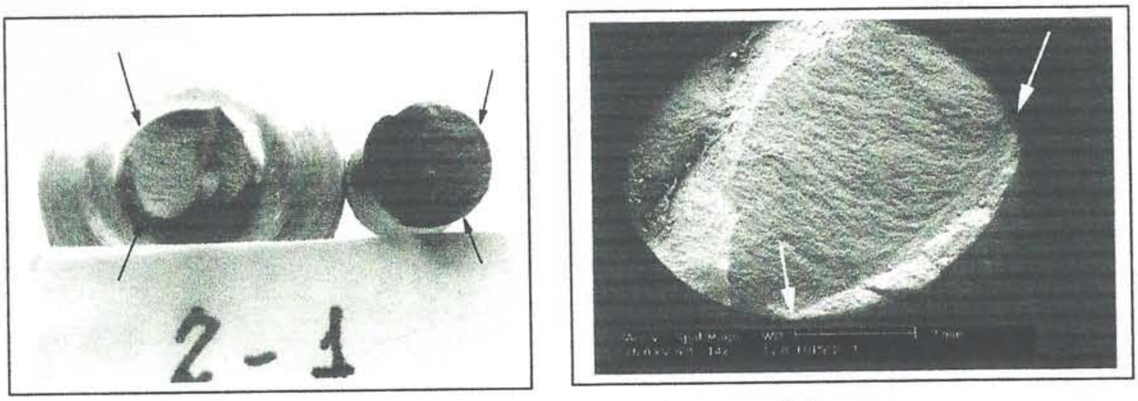
$$M_m = 0{,}926 - 1{,}771\,(a/2r) + 26{,}421\,(a/2r)\wedge 2 - 78{,}481\,(a/2r)\wedge 3 + 87{,}911\,(a/2r)\wedge 4$$

Considerando-se o valor do K_{IC} citado na literatura de 55 MPa $m^{-1/2}$, equivalente a 1740 N.$mm^{-3/2}$, como típico para a liga Ti – 6 Al – 4 V com 1035 MPa de Limite de Escoamento (R. W. Hertzberg – Deformation and Fracture Mechanics of Engineering Materials – pg. 285) e a trinca de 1,75 mm de profundidade, numa seção diametral de 7 mm, observada no parafuso 4-3, pode-se calcular:

S = 593 MPa = 54,4% Limite de Resistência do parafuso 4-3.

Este valor é coerente com a observação de que 2 parafusos romperam por sobrecarga, após a ruptura dos demais a partir de trincas de fadiga pré-existentes.

Fractografias:



(a) (b)

Fig. 27 – Aspecto da fratura do parafuso 2-1. As setas indicam os limites da trinca pré-existente de fadiga. (a) aspecto macroscópico; (b) MEV – imagem de eletrons secundários.

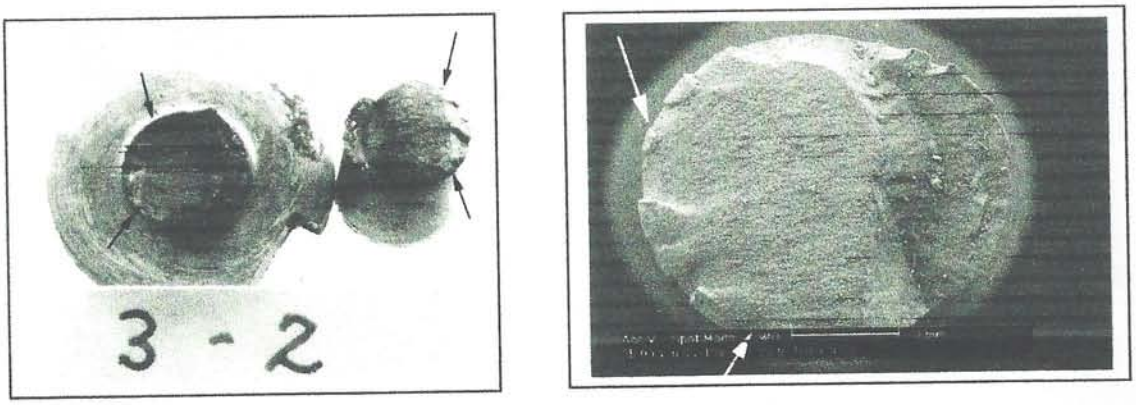


Fig.. 28 – Aspecto da fratura do parafuso 3-2. Análogas à Fig. 26. Nota-se múltipla nucleação (degraus) da fadiga, típica de região de concentração de tensões.

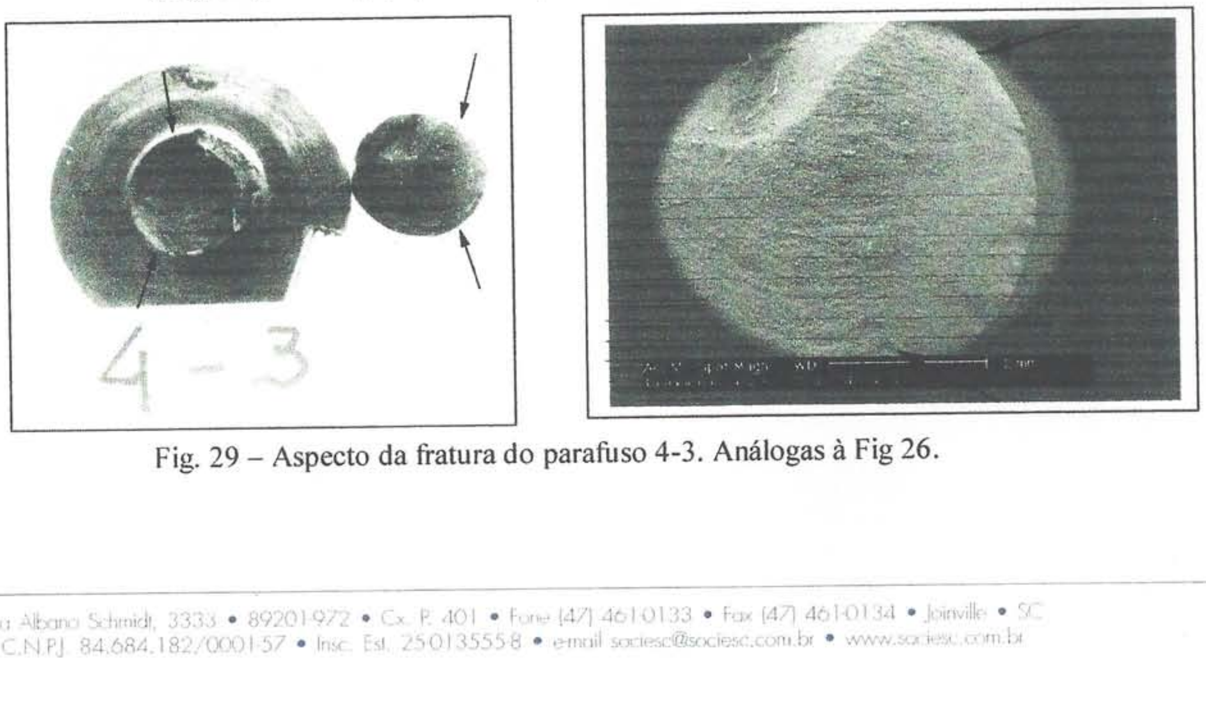


Fig. 29 – Aspecto da fratura do parafuso 4-3. Análogas à Fig 26.

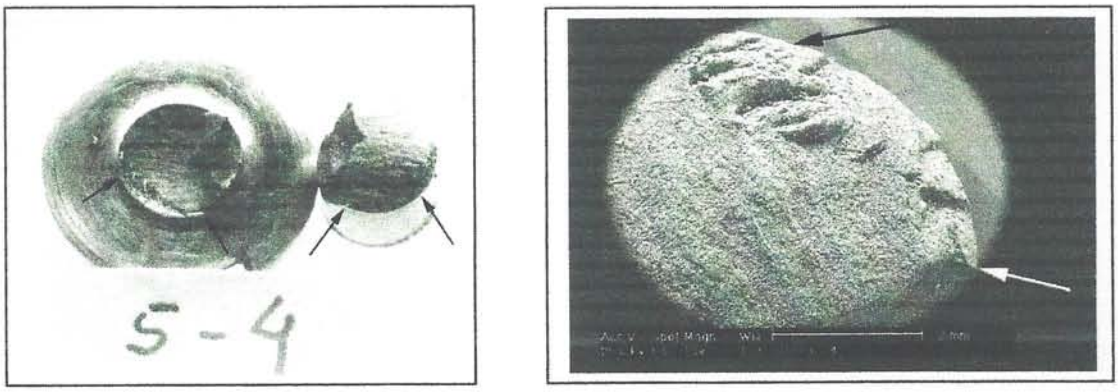


Fig. 30 – Aspecto da fratura do parafuso 5-4. Análogas à Fig. 26

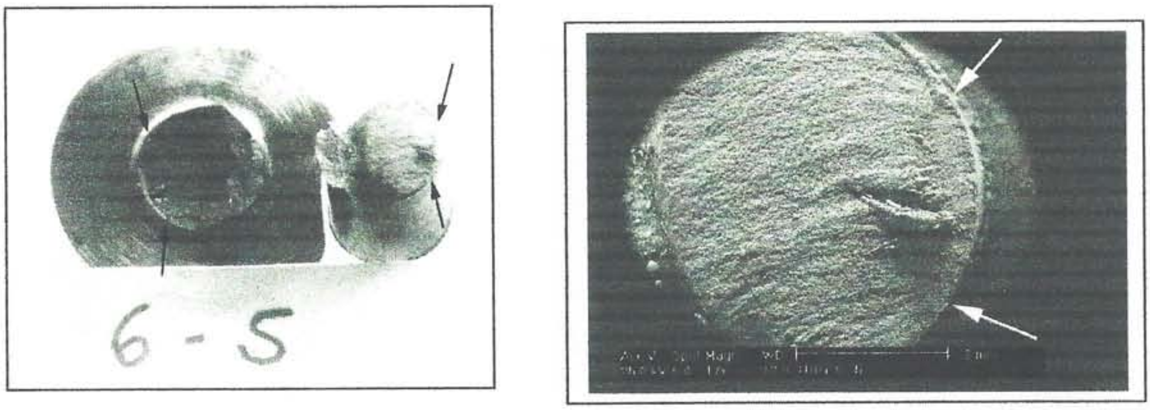


Fig. 31 – Aspecto da fratura do parafuso 6-5. Análogas à Fig. 26.

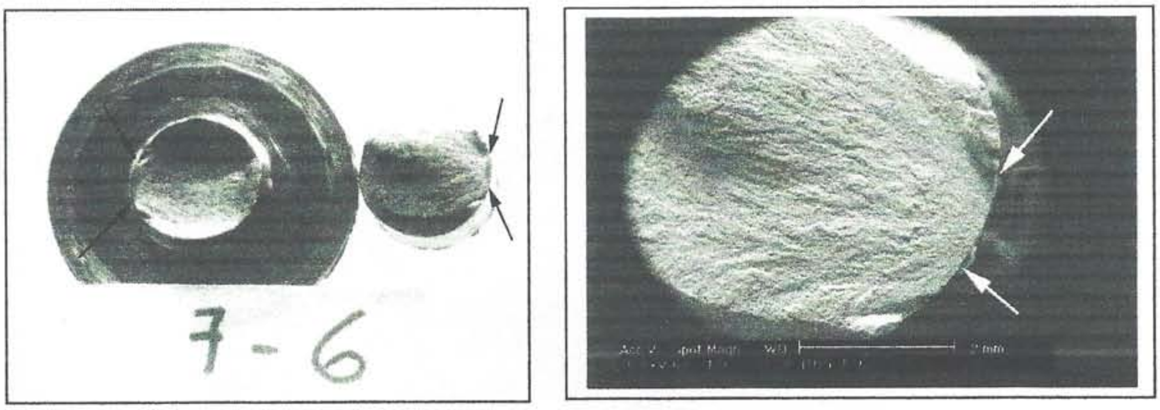


Fig. 32 – Aspecto da fratura do parafuso 7-6. Análogas à Fig.26.

Rua Albano Schmidt, 3333 • 89201-972 • Cx. P. 401 • Fone (47) 461-0133 • Fax (47) 461-0134 • Joinville • SC
C.N.P.J. 84.684.182/0001-57 • Insc. Est. 25-013555-8 • e-mail sociesc@sociesc.com.br • www.sociesc.com.br

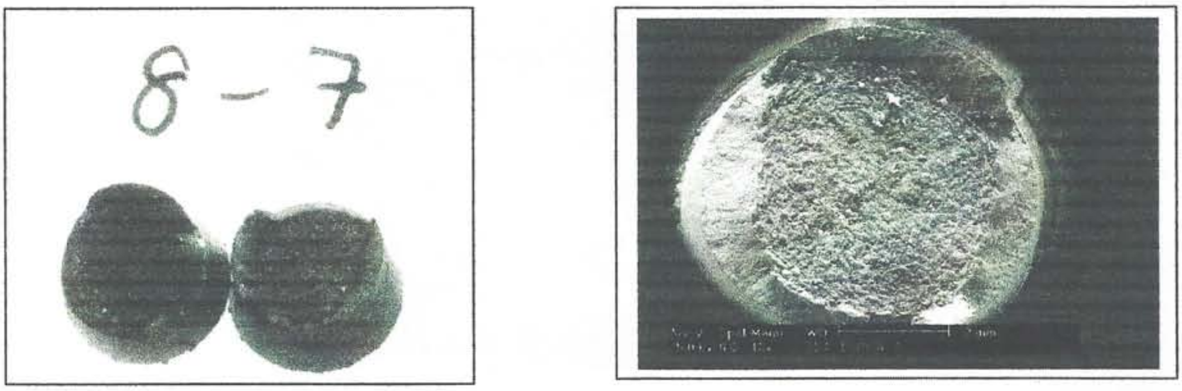


Fig. 33 – Aspecto da fratura do parafuso 8-7. Análogas à Fig.26. Ruptura por sobrecarga dúctil. Região central fibrosa e zona de cizalhamento ("shear lips") junto a superfície externa.

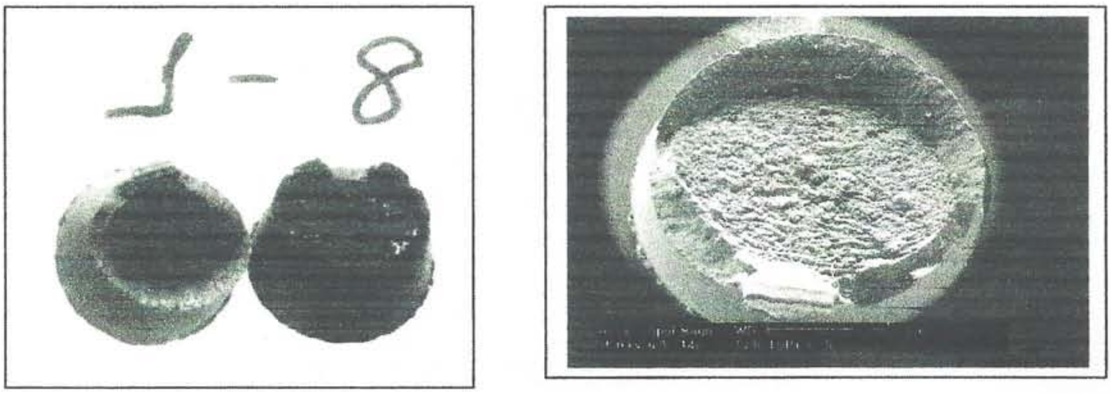


Fig. 34 – Aspecto da fratura do parafuso 1-8. Análogas à Fig. 26. Ruptura por sobrecarga dúctil. Mesmas regiões da FIG. anterior.

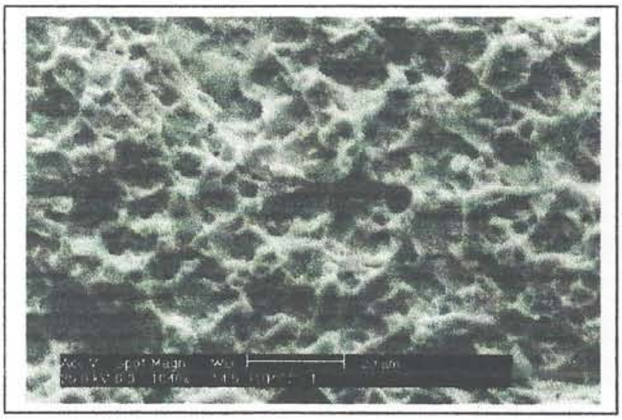


Fig. 35 – MEV. Imagem de elétrons secundários. Aspecto típico da ruptura final nos parafusos rompidos a partir de trinca de fadiga. Ruptura alveolar.

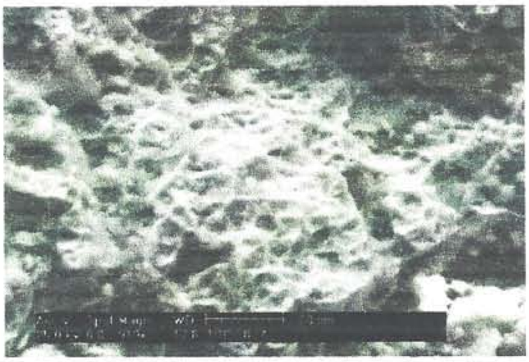


Fig. 36 – MEV. Imagem de elétrons secundários. Aspecto típico da região fibrosa dos parafusos rompidos por sobrecarga dúctil. Ruptura alveolar.

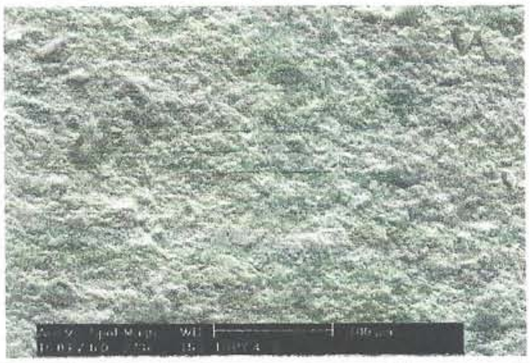


Fig. 37 – MEV. Imagem de elétrons secundários. Aspecto típico da região da fratura por fadiga. Amassamentos, provavelmente conseqüência do fechamento da trinca durante a propagação.

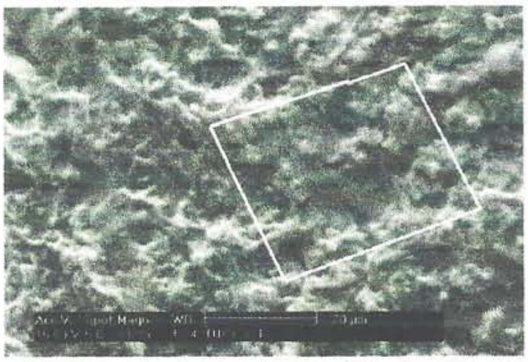


Fig. 38 – MEV. Imagem de elétrons secundários. Pequena região com aspecto típico de estrias de fadiga.

SOCIESC

<table>
<tr><td rowspan="3">LABORATÓRIO DE MATERIAIS</td><td colspan="2">RELATÓRIO</td></tr>
<tr><td>NUMERO</td><td>FOLHA</td></tr>
<tr><td>1547/01</td><td>21/21</td></tr>
</table>

3 – CONCLUSÕES:

- O material dos parafusos apresenta-se dentro das especificações de composição química e resistência mecânica. A caracterização metalográfica não apresentou nenhuma anomalia nas oito microestruturas analisadas.

- Seis dos oito parafusos, a saber, os parafusos 2-1, 3-2, 4-3, 5-4, 6-5 e 7-6, romperam a partir de trincas de fadiga pré-existentes, desenvolvidas sob tensões alternadas, na região de concentração de tensões junto a concordância na extremidade da seção reduzida dos parafusos.
- Os parafusos 4-3 e 3-2 apresentaram as maiores trincas de fadiga, respectivamente, 1,75 e 1,20 mm, aproximadamente, num diâmetro de 7 mm, podendo-se afirmar que foram os primeiros a romper.
- Os parafusos 8-7 e 1-8 apresentaram fratura característica de sobrecarga por tração, tendo rompido na seção reduzida dos parafusos, longe da concordância na extremidade dessa seção.
- As fratura finais ocorreram por mecanismo dúctil, ou seja, coalescimento de micro-cavidades, indicando que o material dos parafusos apresenta boa tenacidade.
- A avaliação aproximada da tensão de ruptura do parafuso 4-3, ou seja, na presença de uma trinca de 1,75 mm de profundidade, pela BS 7910:1999 Amendment 2000, deu 593 MPa, ou seja, 54,4 % do Limite de Ruptura medido no ensaio de tração.

Joinville, 28/11/2001

Iliana G. da Silva
Iliana Goedert da Silva
CRQ – 13200321
Responsável Técnica Laboratório de Materiais

Luciana Stuewe
CRQ - 0663
Laboratório de Materiais

Rua Albano Schmidt, 3333 • 89201-972 • Cx. P. 401 • Fone (47) 461-0133 • Fax (47) 461-0134 • Joinville • SC
C.N.P.J. 84.684.182/0001-57 • Insc. Est. 25.013.555-8 • e-mail sociesc@sociesc.com.br • www.sociesc.com.br

HISTÓRICO DOS BREAKAWAYS COUPLING DAS MONOBÓIAS DE PETRÓLEO DOS TERMINAIS TEFRAN E TEDUT - ANEXO III

Data ocorrência (atuação)	Local	Nº Série do BAC	Dias de Mar	Tipo de manutenção	Posição na linha	Descrição da ocorrência	Observações
03/06/1992	TEFRAN	**GTM 180** **20"x16"**	2983	Manutenção preventiva	Entre 3º e 4º mangotes	Inspeção Preventiva	06 dos 08 parafusos fusíveis foram encontrados partidos, e dois já apresentavam deformação plástica, embora o dispositivo não tivesse atuado.
09/11/1997	TEDUT	**GTM 173** **16"X16"**	-	Manutenção corretiva	Entre 3º e 4º mangotes	Vento repentino de 130 km/h provocou ruptura do cabo de amarração. Navio Maruim ficou portado pelos mangotes. A linha sul ficou sob o bulbo do navio não tracionando a extremidade da linha que estava com o BAC 174, motivo provável da sua não abertura. A linha norte com o BAC 173 foi tracionada havendo a correta abertura do dispositivo.	Foi reparado nas oficinas do TEDUT, voltando a ser instalado na linha norte. Tve os 08 pinos seccionados por tração.
04/10/2001	TEFRAN	**GTM 179** **20"x16"**	2778	Manutenção corretiva.	Entre 3º e 4º mangotes	Durante a descarga do NT Cartola, com condições operacionais normais, o equipamento atuou com mar força 1 na escala Beaufort.	Relatório da SOCIESC indicou que 06 dos 08 parafusos fusíveis romperam à partir de trincas de fadiga. Foi substituido pelo BAC GTM 174.
24/05/2002	TEFRAN	**GTM 180** **20"x16"**	3577	Manutenção corretiva	Entre 3º e 4º mangotes	Durante a descarga do NT Maracá, com condições operacionais normais, o equipamento atuou.	Montado na linha norte do TEFRAN com redução metálica flutuante 20"x16"
21/11/2002	TEFRAN	**GTM 432** **16"x16"**	40	Manutenção Corretiva	Entre 8º e 9º mangotes	Durante a descarga do NT Nordic Savonita, com condições operacionais normais, o equipamento atuou com condições de mar força 5 na escala Beaufort, conforme registro de bordo .	A linha sul se encontra inoperante por falta de BAC reserva.
07/12/2002	TEFRAN	**GTM 174** **16"x16"**	1406	Manutenção Preventiva	-	Estava fora de operação, atuou indevidamente em TH preventivo com 5,0 Kgf/cm².	-
07/12/2002	TEFRAN	**GTM 433** **16"x16"**	154	Manutenção Preventiva	Entre 9º e 10° mangotes	Retirado preventivamente de operação em 06/12/02 atuou indevidamente em TH preventivo com 3,0 Kgf/cm².	Estava em operação há aproximadamente 150 dias.Foi substituido pelo BAC GTM 416 que estava operando no TEDUT.
11/05/2004	TEDUT	**MIB 1857**	81	Manutenção Corretiva	-	Durante a operação do Mt Antíparos, na MN 602, em descarga de petróleo, com pressão de trabalho, em 3,5 kg/cm³, sem nenhuma ação de vento	Introduzido melhorias e eqipamento reinstalado, retirado posteriormente sem ter ativado.
12/06/2004	TEFRAN	**GTM 179** **20"x16"**	226	Manutenção Corretiva		Breakaway ativou-se devido rompimento do cabo nº 74	
12/06/2004	TEFRAN	**GTM 432** **16"x16"**	148	Manutenção Corretiva		Breakaway ativou-se devido rompimento do cabo nº 74	
03/04/2008	TEFRAN	**GTM 179** **20"x16"**	817	Manutenção Corretiva		Breakaway ativou-se, na operação do NT Stenia	
26/01/2012	TEDUT	**GTM 179** **20"x16"**	390	Manutenção Corretiva	Entre 5º e 6ª mangotes	atuação indevida do *Breakaway*. Identificou ainda como agravante à ocorrência, uma falha no funcionamento do dispositivo, que consistiu na não ejeção completa da camisa interna (*sleeve*) do mesmo, impedindo o fechamento das pétalas de bloqueio (lado do navio).	O referindo dispositivo de segurança entrou em operação em 17/08/2010 na Linha Flutuante Interna da MN-601 e foi retirado da referida linha em 31/08/2011, permanecendo no estoque até 10/01/2012, quando entrou em operação na Linha Flutuante Externa da MN-602, portanto com 13 meses de efetiva operação. Teve os 8 pinos seccionados por tração.

Using MBC Valves in offshore marine terminals

RECOMMENDATIONS

- Remove the rigid connection spool piece from the floating hose lines.
- Lock the BAC with a clamp when installing and transporting.
- Lock the BAC when installed but out of operation.
- Increase pin load to 40 ton
- Change pin load design to reduce fatigue effect
- New BAC inspection procedure before each tanker operation
- To Sign a Agreement Cooperation term with the BAC providers (Gall Thomson and MIB) to study and introduce improvements for the BAC.

RECOMMENDATIONS

- Train and Certify personnel in a Local Maintenance office in Brasil

TRANSPETRO

Thank you!

Marcus Soares

TRANSPETRO/PRES/SE/ENG/STSUL