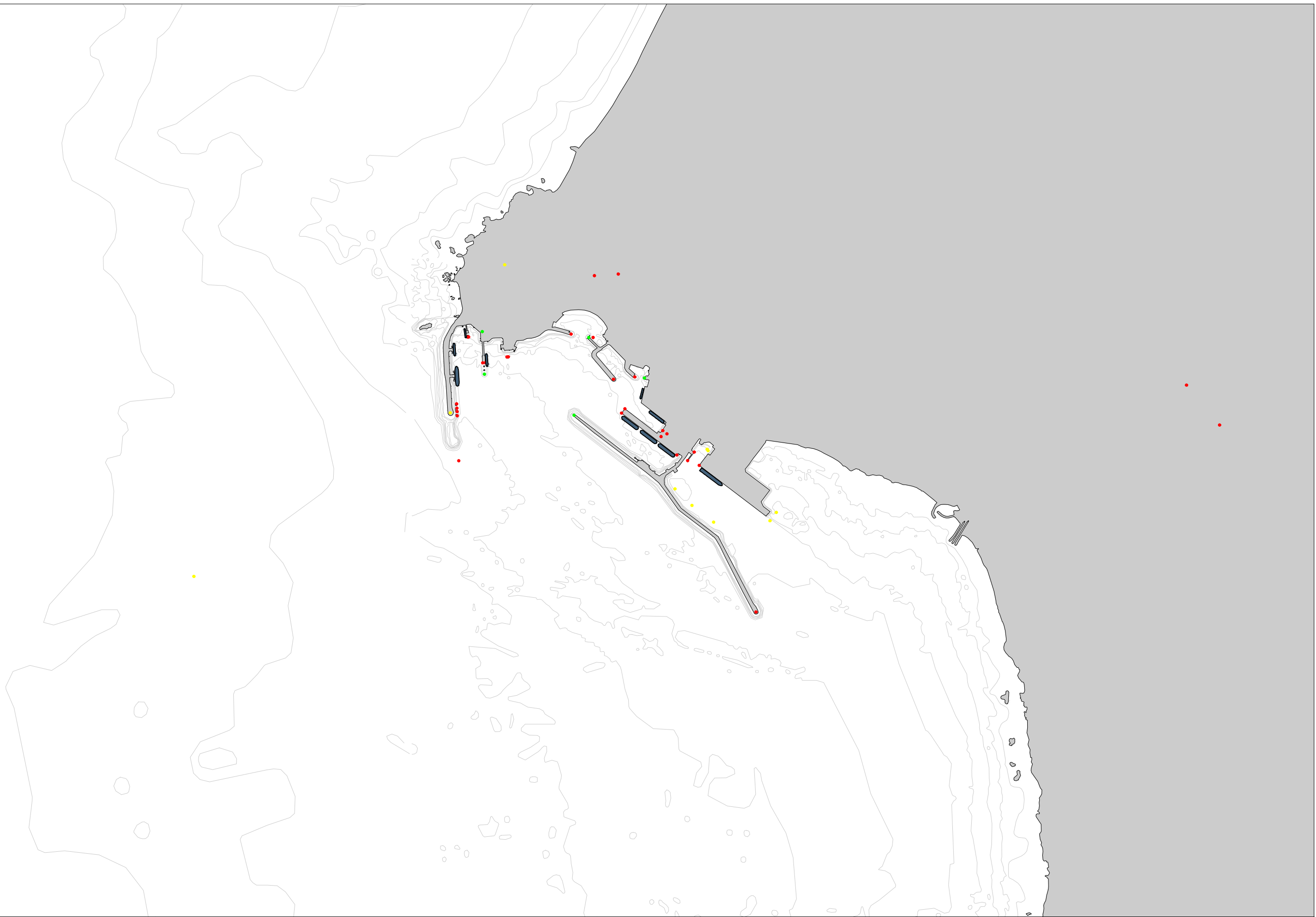
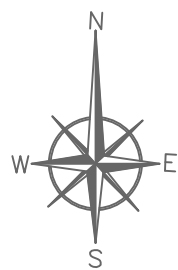


ANEXO I

PLANOS E FOTOGRAFIAS

PLANOS



PROJETO:

Estudos de simulação de manobras para a aproximação de navios metaneiros ao terminal de descarga da REN Atlântico, no Porto de Sines, Portugal

PLANO:

Disposição geral Porto de Sines.
Nova configuração

PÁGINA:

1/2

ESCALA:

1 : 50 000

DATA:

Maió 2026



FOTOGRAFIAS



Figure 1. Simulador em Tempo Real em operação

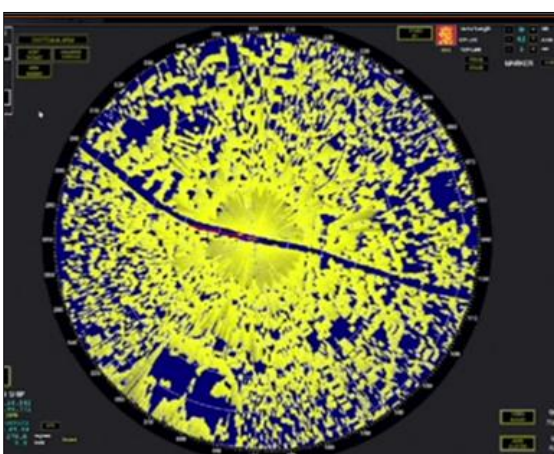


Figure 2. Ecrã do Radar

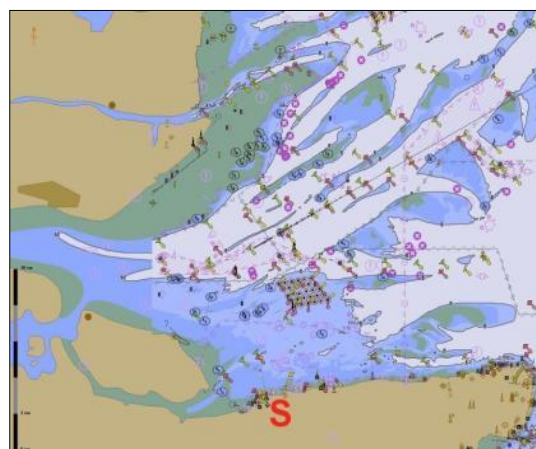


Figure 3. ECDIS

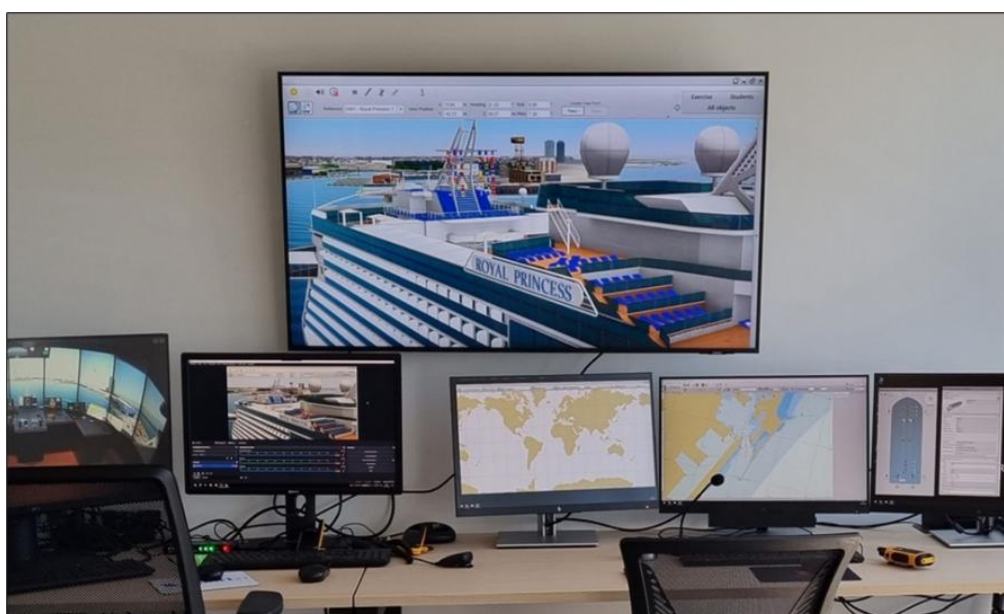


Figure 4. Posição de controle do Simulador



Figure 5. Vista aérea no simulador do Porto de Sines (Portugal)



Figure 6. Navio Q-Flex a efetuar uma manobra de entrada com reviro para o Porto de Sines, Portugal

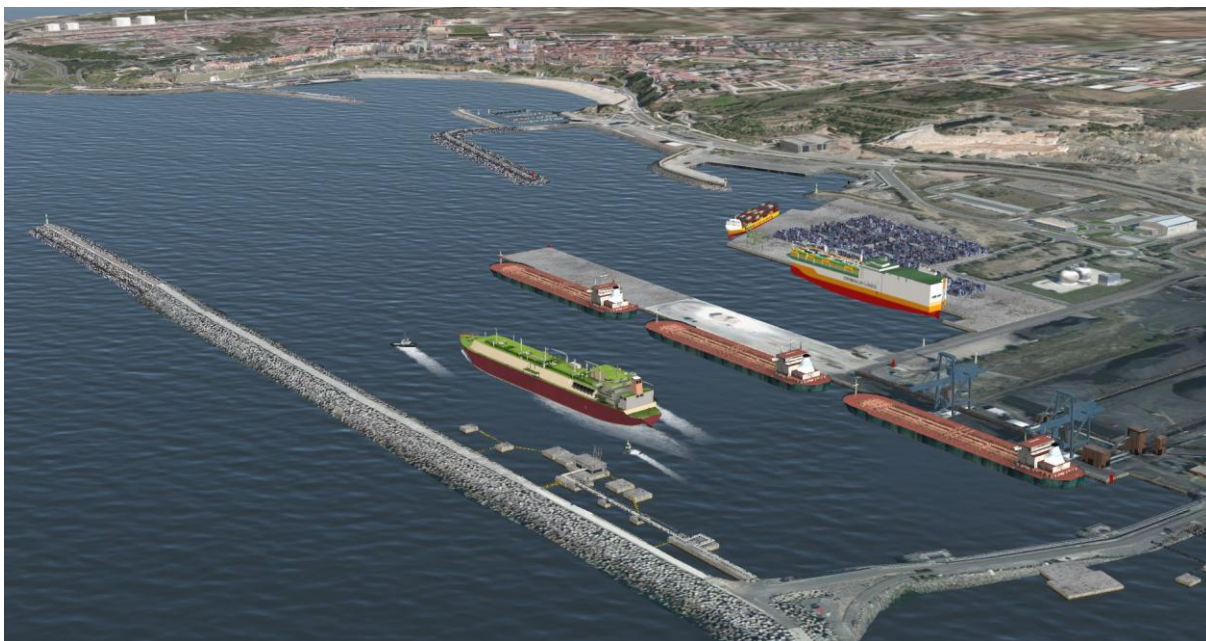


Figure 7. Navio Q-Flex a efetuar uma manobra de saída direta para o Porto de Sines, Portugal



Figure 8. Navio Q-Flex a efetuar uma manobra de entrada com reviro para o Porto de Sines, Portugal

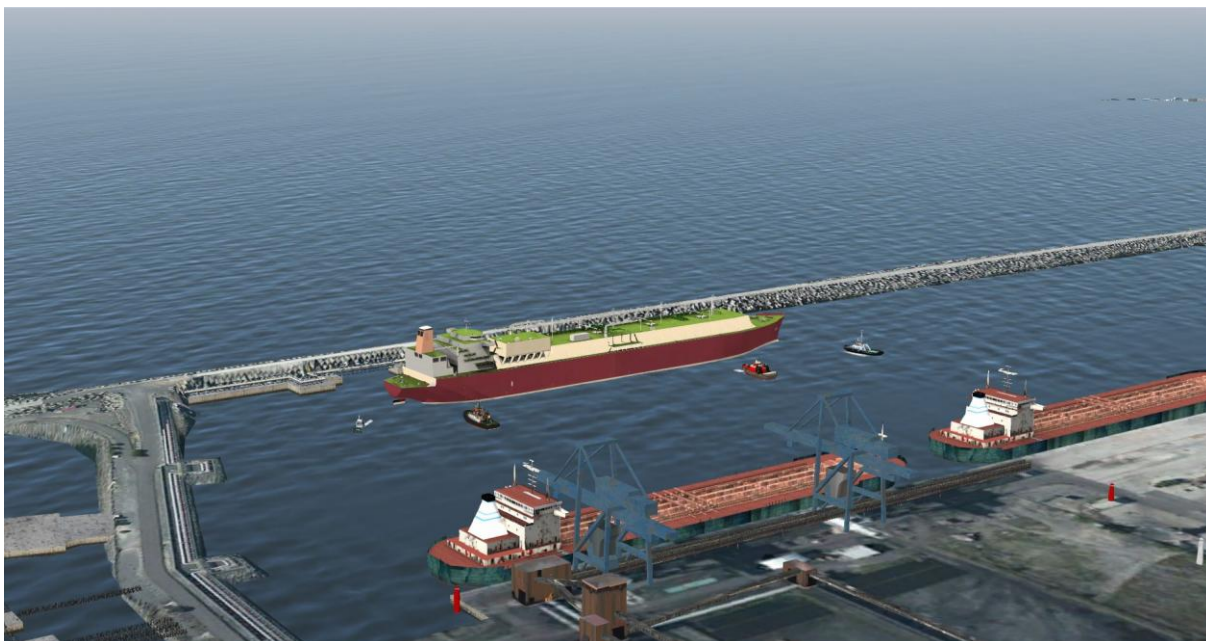


Figure 9. Navio Q-Flex a efetuar uma manobra de saída direta para o Porto de Sines, Portugal



Figure 10. Navio Q-Flex a efetuar uma manobra de entrada com reviro para o Porto de Sines, Portugal

CADERNO DE MANOBRA

Navio de GNL 315.0 m L_{TOT} x 50.0 m B

1. Características da embarcação

Para o barco analisado, apresentam-se as dimensões e características principais junto com seus dados de propulsão e manobra. Na sequência, mostram-se os resultados das provas de manobrabilidade realizadas em modelo matemático. É possível ver os resultados da manobra de giro em águas profundas e águas rasas e manobras de parada.

Tabela 1. Características principais. Navio de GNL 315.0 m L_{TOT}

Navio de GNL 315.0 m L_{TOT}	
Comprimento total	315.0 m
Comprimento entre perpendiculares	302.0 m
Boca.....	50.0 m
Calado (Plena carga)	12.0 m
Calado (Lastro)	9.7 m
Deslocamento (Plena carga).....	142 270 t
Deslocamento (Lastro)	113 000 t
Tipo de motor	Diesel
Potencia	2 x 16550 kW
Nº de propulsores	1
Revoluções máximas.....	83 rpm
Hélice de manobra de proa	-
Velocidade de serviço	20.73 nós
Área frontal exposta ao vento (Plena carga).....	1 550 m ²
Área frontal exposta ao vento (Lastro)	2 830 m ²
Área lateral exposta ao vento (Plena carga)	7 500 m ²
Área lateral exposta ao vento (Lastro).....	7 850 m ²

Tabela 2. Propulsión. Águas profundas

Telégrafo	RPM	Velocidade (nós)
Toda	83	20.7
Toda Porto	63.6278	15.9
Média	52.539	13.1
Pouca	41.5	10.4
Mínima	30.461	7.6

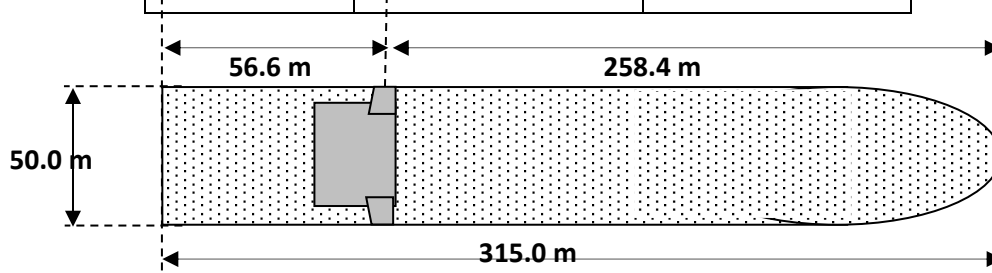


Figura 1. Esquema geral e posição da ponte de comando

2. Condição T = 9.7 m

2.1. Manobra de giro

Tabela 3. Manobra de giro

DADOS DE ENTRADA		
	Águas rasas (h/T=1.2)	Águas profundas (h/T=5.0)
Piloto Automático	OFF	OFF
Velocidade inicial	11.2 nós	13.1 nós
Telégrafo	Média	Média
RPM	640	60000.0
Leme	35°	35.0°
RESULTADOS		
	Águas rasas (h/T=1.2)	Águas profundas (h/T=5.0)
Avanço	1194 m	1015 m
Transferência	782 m	469 m
Diâmetro tático	1547 m	988 m
Diâmetro final	1397 m	528 m
T90	320 s	219 s
T180	582 s	409 s
T270	845 s	608 s
ufinal	8.1 nós	3.6 nós
vfinal	-0.4 nós	-1.6 nós
rfinal	20.5 °/min	26.5 °/min

2.2. Manobra de parada

Tabela 4. Manobra de parada. Águas profundas

DADOS DE ENTRADA		
	Crash stop	Inertial stop
Piloto Automático	OFF	OFF
Velocidade inicial	13.1 nós	13.1 nós
Telégrafo avante	Média	Média
RPM Máquina avante	60000	60000
Telégrafo atrás	Toda Porto	Parada
RPM Máquina atrás	60000	60000
Profundidade	1000 m	1000 m
RESULTADOS		
	Crash stop	Inertial stop
Distância de parada	1,145 m	4,011 m
Tempo de parada	366 s	996 s
Rumo final	0.0°	0.0°
Velocidade final	0.0 nós	5.0 nós

3. Condição T = 12.0 m

3.1. Manobra de giro

Tabela 5. Manobra de giro

DADOS DE ENTRADA		
	Águas rasas (h/T=1.2)	Águas profundas (h/T=5.0)
Piloto Automático	OFF	OFF
Velocidade inicial	10.3 nós	12.9 nós
Telégrafo	Média	Média
RPM	53	52.5
Leme	35°	35.0°
RESULTADOS		
	Águas rasas (h/T=1.2)	Águas profundas (h/T=5.0)
Avanço	1262 m	1111 m
Transferência	867 m	551 m
Diâmetro tático	1716 m	1132 m
Diâmetro final	1564 m	605 m
T90	367 s	244 s
T180	675 s	454 s
T270	984 s	674 s
ufinal	7.7 nós	3.6 nós
vfinal	-0.4 nós	-1.4 nós
rfinal	17.5 °/min	23.8 °/min

3.2. Manobra de parada

Tabela 6. Manobra de parada. Águas profundas

DADOS DE ENTRADA		
	Crash stop	Inertial stop
Piloto Automático	OFF	OFF
Velocidade inicial	12.9 nós	12.9 nós
Telégrafo avante	Média	Média
RPM Máquina avante	53	53
Telégrafo atrás	Toda Porto	Parada
RPM Máquina atrás	-43	0
Profundidade	1000 m	1000 m
RESULTADOS		
	Crash stop	Inertial stop
Distância de parada	1,371 m	4,796 m
Tempo de parada	453 s	1,197 s
Rumo final	0.0°	360.0°
Velocidade final	0.0 nós	5.0 nós

ANEXO III
DESCRIÇÃO DO CENTRO MARÍTIMO
& CERTIFICADOS

DESCRIÇÃO DO CENTRO DE SIMULAÇÃO NAVAL EM TEMPO REAL

TECNOLOGIA: K-SIM



Centro de Simulação Marítima



RUA JOSE ECHEGARAY 8 - EDIFÍCIO ALVIA 1,
2º ANDAR, ESCRITÓRIO 1
28232 LAS ROZAS DE MADRID
ESPAÑA



CENTRO DE SIMULAÇÃO MARÍTIMA

O Centro de Simulação de Manobras Navais em Tempo Real da Siport21 é constituído por três simuladores que podem funcionar individualmente ou em conjunto, para emular situações de tráfego e interação com vários navios ou navios auxiliados por rebocadores, operados por capitães.

O Centro de Simulação implementa inúmeros avanços na engenharia naval, na tecnologia audiovisual e na instrumentação real, permitindo ao Comandante ou Piloto que opera neste sistema trabalhar imerso num ambiente semelhante ao encontrado numa ponte de comando real.

Em conjunto com os programas de formação de capitães, esta ferramenta oferece vantagens especiais na otimização do projeto portuário e da operação de terminais (entrada de novas embarcações, novos terminais, modificações em áreas navegáveis, definição de limites operacionais, definição de estratégias de manobra, requisitos de reboque, situações de emergência, etc.)



LOCALIZAÇÃO

Localizado num dos mais importantes parques tecnológicos de Madrid, no coração do centro empresarial de Las Rozas (Madrid).

Localizado junto à autoestrada A6 A Coruña, a 24 quilómetros de Madrid, a poucos minutos do centro da cidade, com excelentes ligações ao Aeroporto Adolfo Suárez e às estações ferroviárias de Madrid (Atocha e Chamartín).

CARACTERÍSTICAS GERAIS

- Configuração:
 - 2 pontes Full Mission.
 - Tela circular de 287° (11,5 m de diâmetro x 3,0 m de altura) com 7 projetores laser + canal para binóculos.
 - 240° 9 ecrãs LCD 86" 4K + visão traseira e binóculos.
 - 1 ponte Parte da tarefa:
 - 100° 3 ecrãs LCD 86" 4K + visão traseira e binóculos.
 - 2 postos de instrutor: controlos, comunicação, visualização 3D.
 - 2 estações de instrutor simplificadas.
- Certificados:
 - Pontes de missão completa certificadas pela DNV Classe A DNV-ST0033.
 - Pontes de tarefa parcial certificadas pela DNV Classe S DNV-ST0033.
- Fornecedor: KONGSBERG (Noruega).
- Software: K-Sim (simulação) + SeaView R6 (visualização).
- Datas: Início da operação em julho de 2024.

INSTRUMENTAÇÃO

Consolas completas exatamente como as que se encontram nos navios mais modernos, tanto em termos de elementos de controlo (telégrafo do motor, volante/manete(s) de direção, comandos do propulsor azimuthal ou do jato de água direcionável, volante Voith) como de indicadores digitais de todos os tipos, em configurações flexíveis e totalmente versáteis, 100% em conformidade com as normas internacionais.

Além disso, estão incluídos equipamentos reais de radar e ECDIS (carta náutica eletrónica).

PONTE “FULL MISSION” - PROJEÇÃO A LASER



Ponte “Full Mission”

- 5 consolas.
- Telégrafo duplo.
- Roda de proa.
- 2 comandos de leme.
- Hélice de proa/popa.
- Controlos de azimuth.
- Guincho de reboque.
- ECDIS.
- Radar ARPA.
- 4 expositores de instrumentos configuráveis. Painel do piloto automático.
- Painéis de alarme.
- Sistema VHF/DSC.
- Joystick para controlo visual.
- Sistema de som.
- Consola móvel Voith.
- GMDSS.

PONTE “FULL MISION” - LCD



POSIÇÃO DE INSTRUTOR



Ponte “Part Task”

- 3 consolas.
- Telégrafo duplo.
- 2 comandos de leme.
- Hélice de proa/popa.
- Controlos de azimuth.
- Guincho de reboque.
- Radar sintético ARPA.
- Visores de instrumentos configuráveis.
- Painel de piloto automático.
- Painéis de alarme.
- Sistema VHF/DSC.
- Joystick para controlo visual.
- Sistema de som.

PONTE “PART TASK”



SOFTWARE K-SIM

O software de simulação (K-Sim da Kongsberg) foi concebido e configurado com base nas plataformas de simulação da Kongsberg Digital, conhecidas como tecnologia Spirit. Esta tecnologia permite designs altamente flexíveis, modulares e configuráveis, que podem integrar simulações individuais ou múltiplas e possibilitar aos instrutores/controladores ligarem-se a qualquer simulador do catálogo. O K-Sim foi lançado em 2017 e ganhou uma versão cloud em 2023, como parte de um programa de melhoria contínua. O K-Sim utiliza um motor de física de alta fidelidade, o AgX, concebido de acordo com os princípios da física sandbox. Durante a preparação e o projeto de cada objeto de simulação, são atribuídos os parâmetros e os atributos físicos correspondentes. Isto garante o máximo realismo na precisão e no comportamento físico de cada objeto durante a simulação em tempo real. Este motor de física funciona nativamente em unidades de processamento gráfico (GPUs), oferecendo desempenho e qualidade em linha com as mais recentes tecnologias desenvolvidas no mundo da simulação virtual.

O sistema visual de última geração, SeaView R6 (Kongsberg), permite a apresentação de todo o tipo de efeitos: ondas, rastos, cobertura de nuvens e fumo, helicópteros, veículos a movimentarem-se no cais, pessoas no convés, operações dinâmicas como movimentos de gruas no navio, manchas de derrame na água, etc.

MODELOS DE SIMULAÇÃO DISPONÍVEIS

- 110 portos internacionais (em conversão progressiva para o novo sistema).
- 400 embarcações de diversos tipos e tamanhos (em conversão progressiva para o novo sistema).
- Capacidade autónoma para gerar novos modelos de portos e embarcações.

FUNCIONALIDADE

- Área total do Centro: 450 metros quadrados.
- Aplicações em projetos portuários e/ou formação de forma totalmente flexível.
- Capacidade para operação independente ou sincronizada (2/3 embarcações na mesma área de simulação).
- Diversos tipos de embarcações.
- Propulsão convencional/ASD/azipods/jets de água/Voith.
- Rebocadores convencionais/ASD/Voith.
- 3 salas de controlo/instrutor independentes.
- Até 4 sessões de treino diárias em turnos duplos.
- Salas de reunião para briefing/debriefing com Capitães/Pilotos.
- Utilização prevista: 1200 horas líquidas de simulação/ano (variação de 1000 a 1400).



KONGSBERG

A Kongsberg Maritime (Noruega) é o fornecedor do novo Centro de Simulação. Trata-se de uma empresa especializada no fabrico de consolas de instrumentos de navegação para pontes de navios reais e simuladores de todos os tipos: pontes de navegação e manobra, controlo de tráfego aéreo (VTS), salas de máquinas, etc. Há décadas que fornece centenas de sistemas a centros de formação náutica e empresas de investigação e engenharia em todo o mundo. A empresa atualiza e melhora regularmente o seu software de simulação (NMS-90, Polaris e K-Sim nos últimos anos).

CERTIFICADO DO PRODUTO

PRODUCT CERTIFICATE

Certificate no.:
n1990441-ccc K-Sim®
Bridge 1
DNV ID no.:
10062583

Particulars of Product

Function Area:	BRIDGE OPERATION SIMULATOR
Class notation:	INTEGRATED SIMULATOR SYSTEM, ICE, TUG, IN
Name and type designation:	K-Sim® Navigation Manoeuvring Simulator (Bridge 1)
In use for simulation at:	SIPORT XXI S.L. C/José Echegaray, 8 Edificio Alvia 1, Planta 2 28232 Las Rozas (Madrid) SPAIN

Particulars of Manufacturer

Manufacturer:	Kongsberg Digital AS
Manufacturer address:	Maritime Simulation, Horten, Norway

This is to certify:

That the above product is found to comply with Class A - Standard for Certification of Maritime Simulators No. DNV-ST-0033 June 2021.

Application

The above Standard is based on requirements in the STCW Convention, Regulation I/12 and corresponding industry standard and guidelines.

This Certificate is valid until **2029-07-24**, provided the requirements for the retention of the Certificate will be complied with.

Issued at **Sandefjord, Norway** on **2024-07-24**



for **DNV**

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n1990441-ccc and ID: 10062583*

Aksel David Nordholm
Approval Expert

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Form code: MSS 311
UTN: n1990441-ccc

Revision: 2023-07

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Application/Limitation

The primary objective of the ship manoeuvring simulator is the execution of studies on the port approach of vessels under different physical and environmental conditions for the adequate layout design of the port, the approach channel and manoeuvring zones. Another important objective is to use it for Pilots, Captains and Officers education and training, either in a basic level or for specialised, advanced or retraining courses.

The ship manoeuvring simulator system is applicable and aims for the execution of studies on the port approach and inland waterways of vessels under different physical and environmental conditions for the adequate layout design of the port, the approach channel, and manoeuvring zones. This system allows, as well, Pilots, Captains and Officers education and training, either in a basic level or for specialised, advanced, or retraining courses, as per the requirements in the STCW Convention, Regulation I/12 and corresponding industry standard and guidelines.

The simulator can simulate a realistic environment for selected STCW competence requirement referred to in Table 3-2.

Table 3-2 Competencies addressed by bridge operation simulator class

<i>STCW reference</i>	<i>Competence</i>	<i>Class A (NAV)</i>	<i>Class B (NAV)</i>	<i>Class C (NAV)</i>
Table A-II/1.1	Plan and conduct a passage and determine position.	A	B	
Table A-II/1.2	Maintain a safe navigational watch.	A	B	
Table A-II/1.3	Use of radar and ARPA to maintain safety of navigation.	A	B	C
Table A-II/1.4	Use of ECDIS to maintain the safety of navigation.	A	B	C
Table A-II/1.5	Respond to emergencies.	A	B	C
Table A-II/1.6	Respond to a distress signal at sea.	A	B	C
Table A-II/1.8	Transmit and receive information by visual signalling.	A	B	C
Table A-II/1.9	Manoeuvre the ship.	A	B	C
Table A-II/2.1	Plan a voyage and conduct navigation.	A	B	
Table A-II/2.2	Determine position and the accuracy of resultant position fix by any means.	A	B	
Table A-II/2.3	Determine and allow for compass errors.	A	B	
Table A-II/2.4	Co-ordinate search and rescue operations.	A	B	
Table A-II/2.5	Establish watchkeeping arrangements and procedures.	A	B	
Table A-II/2.6	Maintain safe navigation through the use of information from navigation equipment and systems to assist command decision-making.	A	B	C
Table A-II/2.7	Maintain the safety of navigation through the use of ECDIS and associated navigation systems to assist command decision making.	A	B	C
Table A-II/2.10	Manoeuvre and handle a ship in all conditions.	A		
Table A-II/2.11	Operate remote controls of propulsion plant and engineering systems and services.	A		
Table A-II/3.1	Plan and conduct a coastal passage and determine position.	A	B	
Table A-II/3.2	Maintain a safe navigational watch.	A	B	
Table A-II/3.3	Respond to emergencies.	A	B	C
Table A-II/3.4	Respond to a distress signal at sea.	A	B	C
Table A-II/3.5	Manoeuvre the ship and operate small ship power plants.	A		
Table A-II/4.1	Steer the ship and also comply with helm orders in the English language.	A	B	C
Table A-II/4.2	Keep a proper look-out by sight and hearing.	A	B	C
Table A-II/5.2	Contribute to berthing, anchoring and other mooring operations.	A	B	C
Table A-V/4-1.1	Contribute to safe operation of vessels operating in polar waters.	A	B	

<i>STCW reference</i>	<i>Competence</i>	<i>Class A (NAV)</i>	<i>Class B (NAV)</i>	<i>Class C (NAV)</i>
Table A-V/4-1.2	Monitor and ensure compliance with legislative requirements.	A	B	
Table A-V/4-1.3	Apply safe working practices, respond to emergencies.	A	B	
Table A-V/4-1.4	Ensure compliance with pollution-prevention requirements and prevent environmental hazards.	A	B	
Table A-V/4-2.1	Plan and conduct a voyage in polar waters.	A	B	
Table A-V/4-2.2	Manage the safe operation of vessels operating in polar waters.	A	B	
Table A-V/4-2.3	Maintain safety of the ship's crew and passengers and the operational condition of lifesaving, fire-fighting and other safety systems.	A	B	

Endorsement for Annual Audits

THIS IS TO CERTIFY:

at an annual audit as required by the Standard, the Simulator System was found to comply with the relevant requirements of the Standard.

1st Annual Audit

Place: **Madrid, Spain**

Date: **2025-03-04**



Signature: **Aksel David Nordholm**

Auditor, DNV

2nd Annual Audit

Place: **Sandefjord, Norway**

Date: **2026-04-08**



Signature: **Aksel David Nordholm**

Auditor, DNV

3rd Annual Audit

Place: _____

Date: _____

Signature: _____

Auditor, DNV

Stamp

4th Annual Audit

Place: _____

Date: _____

Signature: _____

Auditor, DNV

Stamp

PRODUCT CERTIFICATE

Certificate no.:
n1990441-rah K-Sim®
Bridge 2
DNV ID no.:
10062583

Particulars of Product

Function Area:	BRIDGE OPERATION SIMULATOR
Class notation:	INTEGRATED SIMULATOR SYSTEM, ICE, TUG, IN
Name and type designation:	K-Sim® Navigation Manoeuvring Simulator (Bridge 2)
In use for simulation at:	SIPORT XXI S.L. C/José Echegaray, 8 Edificio Alvia 1, Planta 2 28232 Las Rozas (Madrid) SPAIN

Particulars of Manufacturer

Manufacturer:	Kongsberg Digital AS
Manufacturer address:	Maritime Simulation, Horten, Norway

This is to certify:

That the above product is found to comply with Class A - Standard for Certification of Maritime Simulators No. DNV-ST-0033 June 2021.

Application

The above Standard is based on requirements in the STCW Convention, Regulation I/12 and corresponding industry standard and guidelines.

This Certificate is valid until **2029-07-24**, provided the requirements for the retention of the Certificate will be complied with.

Issued at **Sandefjord, Norway** on **2024-07-24**



for **DNV**

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Aksel David Nordholm
Approval Expert

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UTN: n1990441-rah

Application/Limitation

The primary objective of the ship manoeuvring simulator is the execution of studies on the port approach of vessels under different physical and environmental conditions for the adequate layout design of the port, the approach channel and manoeuvring zones. Another important objective is to use it for Pilots, Captains and Officers education and training, either in a basic level or for specialised, advanced or retraining courses.

The ship manoeuvring simulator system is applicable and aims for the execution of studies on the port approach and inland waterways of vessels under different physical and environmental conditions for the adequate layout design of the port, the approach channel, and manoeuvring zones. This system allows, as well, Pilots, Captains and Officers education and training, either in a basic level or for specialised, advanced, or retraining courses, as per the requirements in the STCW Convention, Regulation I/12 and corresponding industry standard and guidelines.

The simulator can simulate a realistic environment for selected STCW competence requirement referred to in Table 3-2.

Table 3-2 Competencies addressed by bridge operation simulator class

<i>STCW reference</i>	<i>Competence</i>	<i>Class A (NAV)</i>	<i>Class B (NAV)</i>	<i>Class C (NAV)</i>
Table A-II/1.1	Plan and conduct a passage and determine position.	A	B	
Table A-II/1.2	Maintain a safe navigational watch.	A	B	
Table A-II/1.3	Use of radar and ARPA to maintain safety of navigation.	A	B	C
Table A-II/1.4	Use of ECDIS to maintain the safety of navigation.	A	B	C
Table A-II/1.5	Respond to emergencies.	A	B	C
Table A-II/1.6	Respond to a distress signal at sea.	A	B	C
Table A-II/1.8	Transmit and receive information by visual signalling.	A	B	C
Table A-II/1.9	Manoeuvre the ship.	A	B	C
Table A-II/2.1	Plan a voyage and conduct navigation.	A	B	
Table A-II/2.2	Determine position and the accuracy of resultant position fix by any means.	A	B	
Table A-II/2.3	Determine and allow for compass errors.	A	B	
Table A-II/2.4	Co-ordinate search and rescue operations.	A	B	
Table A-II/2.5	Establish watchkeeping arrangements and procedures.	A	B	
Table A-II/2.6	Maintain safe navigation through the use of information from navigation equipment and systems to assist command decision-making.	A	B	C
Table A-II/2.7	Maintain the safety of navigation through the use of ECDIS and associated navigation systems to assist command decision making.	A	B	C
Table A-II/2.10	Manoeuvre and handle a ship in all conditions.	A		
Table A-II/2.11	Operate remote controls of propulsion plant and engineering systems and services.	A		
Table A-II/3.1	Plan and conduct a coastal passage and determine position.	A	B	
Table A-II/3.2	Maintain a safe navigational watch.	A	B	
Table A-II/3.3	Respond to emergencies.	A	B	C
Table A-II/3.4	Respond to a distress signal at sea.	A	B	C
Table A-II/3.5	Manoeuvre the ship and operate small ship power plants.	A		
Table A-II/4.1	Steer the ship and also comply with helm orders in the English language.	A	B	C
Table A-II/4.2	Keep a proper look-out by sight and hearing.	A	B	C
Table A-II/5.2	Contribute to berthing, anchoring and other mooring operations.	A	B	C
Table A-V/4-1.1	Contribute to safe operation of vessels operating in polar waters.	A	B	

<i>STCW reference</i>	<i>Competence</i>	<i>Class A (NAV)</i>	<i>Class B (NAV)</i>	<i>Class C (NAV)</i>
Table A-V/4-1.2	Monitor and ensure compliance with legislative requirements.	A	B	
Table A-V/4-1.3	Apply safe working practices, respond to emergencies.	A	B	
Table A-V/4-1.4	Ensure compliance with pollution-prevention requirements and prevent environmental hazards.	A	B	
Table A-V/4-2.1	Plan and conduct a voyage in polar waters.	A	B	
Table A-V/4-2.2	Manage the safe operation of vessels operating in polar waters.	A	B	
Table A-V/4-2.3	Maintain safety of the ship's crew and passengers and the operational condition of lifesaving, fire-fighting and other safety systems.	A	B	

Endorsement for Annual Audits

THIS IS TO CERTIFY:

at an annual audit as required by the Standard, the Simulator System was found to comply with the relevant requirements of the Standard.

1st Annual Audit

Place: **Madrid, Spain**

Date: **2025-03-04**



Signature: **Aksel David Nordholm**

Auditor, DNV

2nd Annual Audit

Place: **Sandefjord, Norway**

Date: **2026-04-08**



Signature: **Aksel David Nordholm**

Auditor, DNV

3rd Annual Audit

Place: _____

Date: _____

Signature: _____

Stamp

Auditor, DNV

4th Annual Audit

Place: _____

Date: _____

Signature: _____

Stamp

Auditor, DNV

PRODUCT CERTIFICATE

Certificate no.:
n1990441-jwi K-Sim®
Tug
DNV ID no.:
10062583

Particulars of Product

Function Area:	BRIDGE OPERATION SIMULATOR
Class notation:	INTEGRATED SIMULATOR SYSTEM, ICE, TUG,
Name and type designation:	K-Sim® Navigation Manoeuvring Simulator (Tug bridge)
In use for simulation at:	SIPORT XXI S.L. C/José Echegaray, 8 Edificio Alvia 1, Planta 2 28232 Las Rozas (Madrid) SPAIN

Particulars of Manufacturer

Manufacturer:	Kongsberg Digital AS
Manufacturer address:	Maritime Simulation, Horten, Norway

This is to certify:

That the above product is found to comply with Class S - Standard for Certification of Maritime Simulators No. DNV-ST-0033 June 2021.

Application

The above Standard is based on requirements in the STCW Convention, Regulation I/12 and corresponding industry standard and guidelines.

This Certificate is valid until **2029-07-24**, provided the requirements for the retention of the Certificate will be complied with.

Issued at **Sandefjord, Norway** on **2024-07-24**



for DNV

*This document is signed electronically in accordance with IMO
FAL.5/Circ.39/Rev.2. Validation and authentication can be obtained from
trust.dnv.com by using the Unique Tracking Number (UTN):
n1990441-jwi and ID: 10062583*

Aksel David Nordholm
Approval Expert

This Certificate is subject to terms and conditions overleaf. Any significant change in simulation performance may render this Certificate invalid.
LEGAL DISCLAIMER: Unless otherwise stated in the applicable contract with the holder of this document, or following from mandatory law, the liability of DNV AS, its parent companies and their subsidiaries as well as their officers, directors and employees ("DNV") arising from or in connection with the services rendered for the purpose of the issuance of this document or reliance thereon, whether in contract or in tort (including negligence), shall be limited to direct losses and under any circumstance be limited to 300,000 USD.



Form code: MSS 311

Revision: 2023-07

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Page 1 of 3

UTN: n1990441-jwi

Application/Limitation

The primary objective of the ship manoeuvring simulator is the execution of studies on the port approach of vessels under different physical and environmental conditions for the adequate layout design of the port, the approach channel and manoeuvring zones. Another important objective is to use it for Pilots, Captains and Officers education and training, either in a basic level or for specialised, advanced or retraining courses.

The ship manoeuvring simulator system is applicable and aims for the execution of studies on the port approach and inland waterways of vessels under different physical and environmental conditions for the adequate layout design of the port, the approach channel, and manoeuvring zones. This system allows, as well, Pilots, Captains and Officers education and training, either in a basic level or for specialised, advanced, or retraining courses, as per the requirements in the STCW Convention, Regulation I/12 and corresponding industry standard and guidelines.

Endorsement for Annual Audits

THIS IS TO CERTIFY:

at an annual audit as required by the Standard, the Simulator System was found to comply with the relevant requirements of the Standard.

1st Annual Audit

Place: **Madrid, Spain**

Date: **2025-03-04**



Signature: **Aksel David Nordholm**

Auditor, DNV

2nd Annual Audit

Place: **Sandefjord, Norway**

Date: **2026-04-08**



Signature: **Aksel David Nordholm**

Auditor, DNV

3rd Annual Audit

Place: _____

Date: _____

Signature: _____

Stamp

Auditor, DNV

4th Annual Audit

Place: _____

Date: _____

Signature: _____

Stamp

Auditor, DNV

ANEXO IV

GRÁFICOS DE TRAJECTÓRIAS E

SÉRIES TEMPORAIS

O presente anexo contém as seguintes informações para cada manobra:

- ▶ **Gráficos de trajetória**, com o contorno do porto e a posição do barco a intervalos de tempo prefixados (60 s).
- ▶ **Séries temporais** de diferentes variáveis do barco (velocidade, revoluções da máquina, ângulo do leme, componentes da velocidade, velocidade de guinada, rumo e uso das hélices de manobra) e de rebocadores (força total (FX, Fy) e momento total (M)). Também se incluem variáveis meteorológicas (vento e ondas) ao longo da simulação.

A tabela seguinte apresenta as manobras realizadas:

Tabela 1. Casos analisados

Navio	Condição	Manobra	Vento	Ondas	Rebocadores	Run
Q-Flex LNG Carrier 216 000 m ³	Plena carga	Entrada com reviro	NE 20 kn	NW Hs 2.0 m Tp 9 s	4 (25 t + 75 t + 50 t + 25 t)	1001
			SW 20 kn	SW Hs 2.0 m Tp 10 s	4 (25 t + 75 t + 50 t + 25 t)	3002
			NW 20 kn	NW Hs 2.0 m Tp 9 s	4 (25 t + 75 t + 50 t + 25 t)	1002
			NE 25 kn	NW Hs 2.0 m Tp 9 s	4 (50 t + 75 t + 80 t + 25 t)	2003
			SW 25 kn	SW Hs 2.0 m Tp 10 s	4 (50 t + 75 t + 80 t + 25 t)	2001
			NW 25 kn	NW Hs 2.0 m Tp 9 s	4 (50 t + 75 t + 80 t + 25 t)	2002
	Lastro	Saída direta	NE 20 kn	NW Hs 2.0 m Tp 9 s	4 (25 t + 75 t + 50 t + 25 t)	1003
			SW 20 kn	SW Hs 2.0 m Tp 10 s	4 (25 t + 75 t + 50 t + 25 t)	2004
			NW 20 kn	NW Hs 2.0 m Tp 9 s	4 (25 t + 75 t + 50 t + 25 t)	2007
			NE 25 kn	NW Hs 2.0 m Tp 9 s	4 (50 t + 75 t + 80 t + 25 t)	2006
			SW 25 kn	SW Hs 2.0 m Tp 10 s	4 (50 t + 75 t + 80 t + 25 t)	2005
			NW 25 kn	NW Hs 2.0 m Tp 9 s	4 (50 t + 75 t + 80 t + 25 t)	3001

RUN 1001

**Q-Flex LNG Carrier 216 000 m³. Plena carga.
Entrada com reviro**

Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

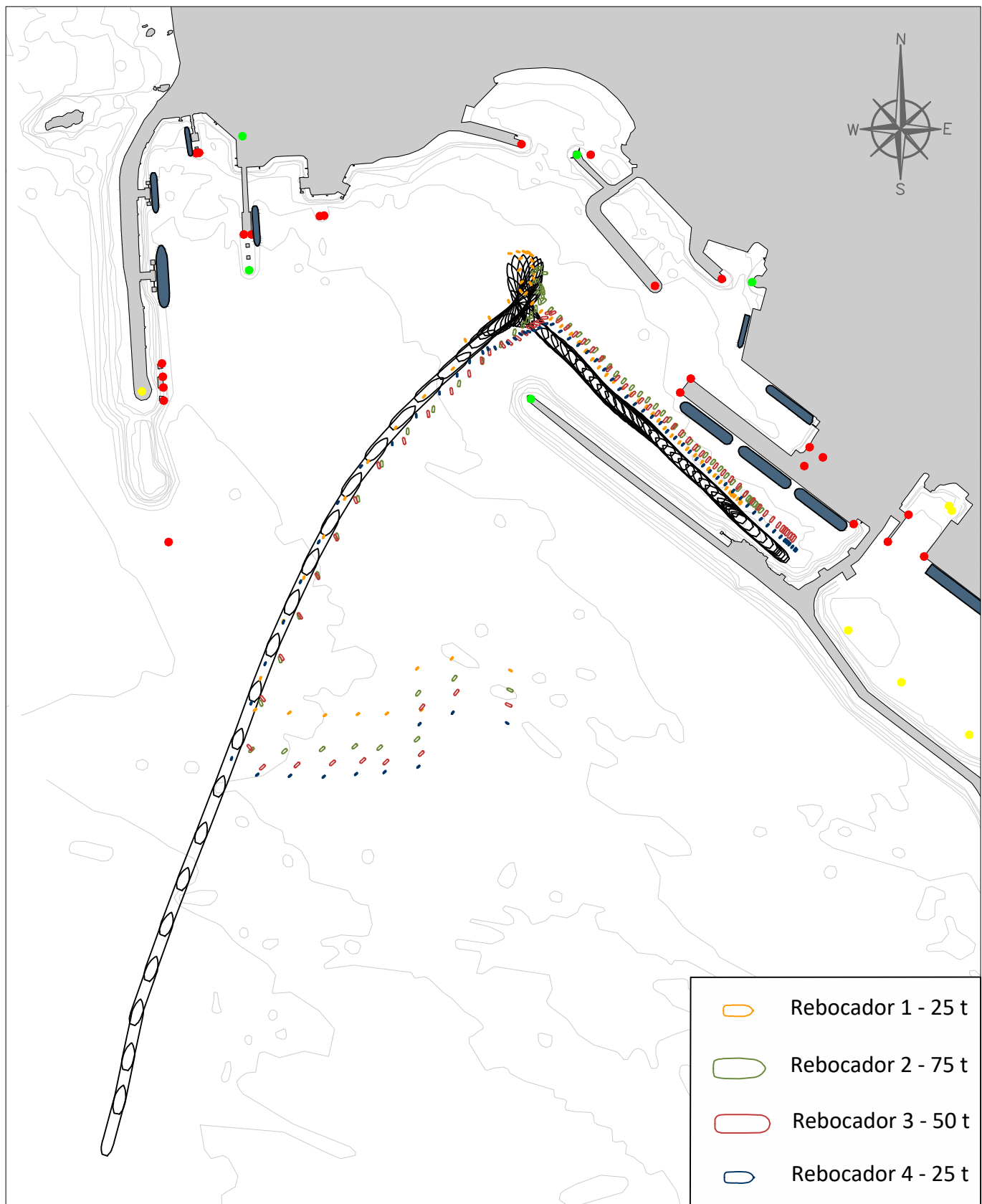


Figure: Trk-1001

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 6 000

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales

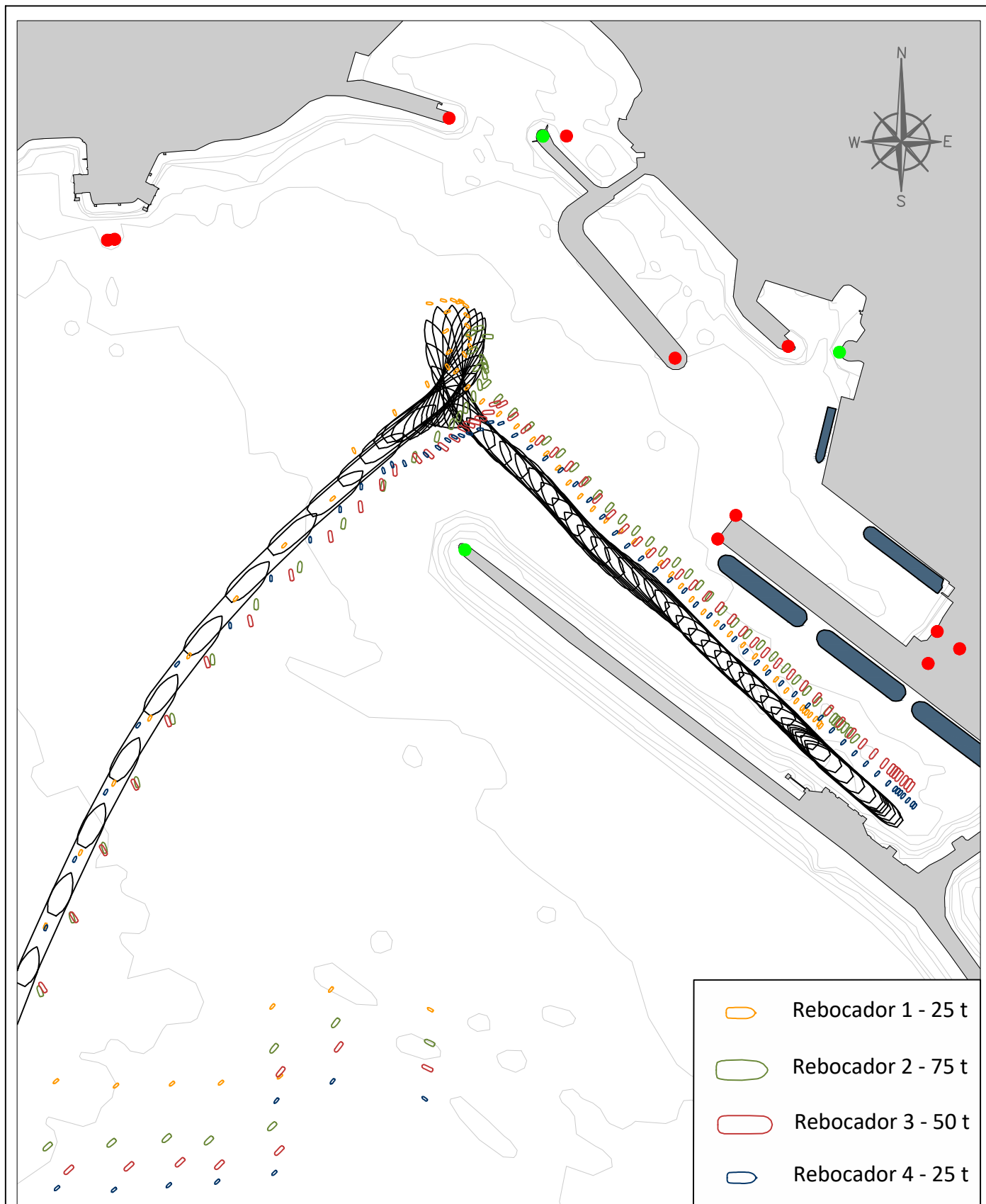


Figure: Trk-1001

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

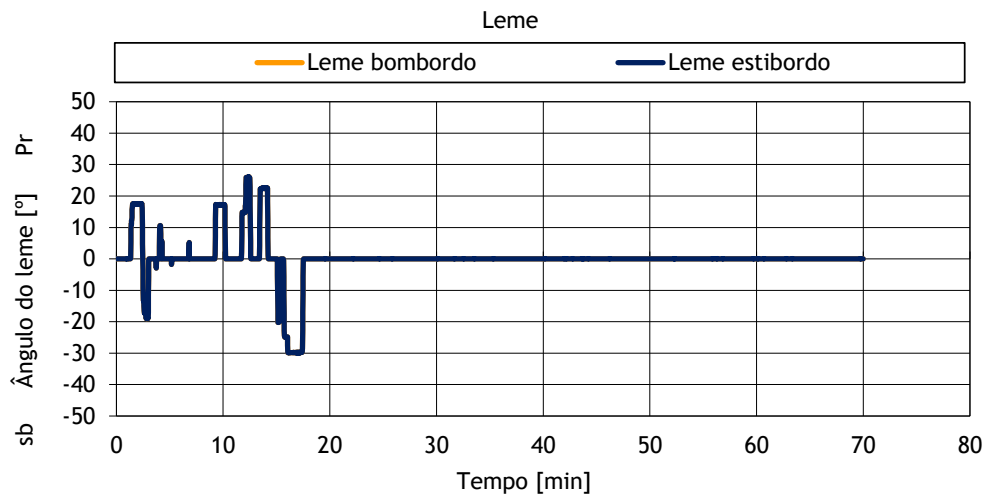
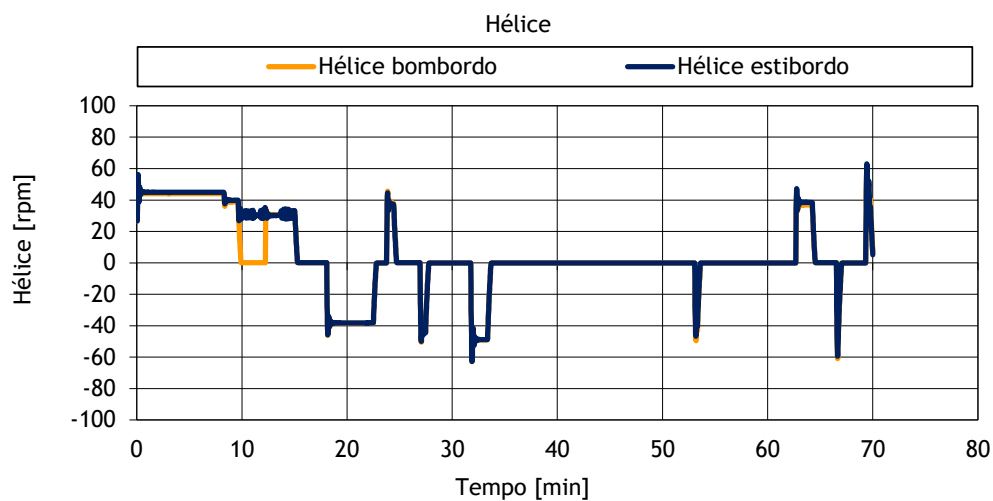
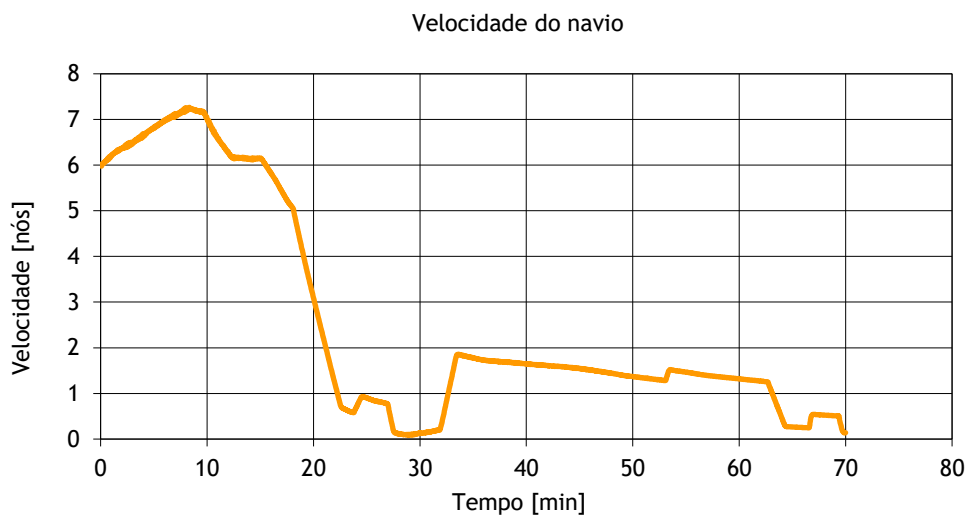
Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 3 500

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 1001

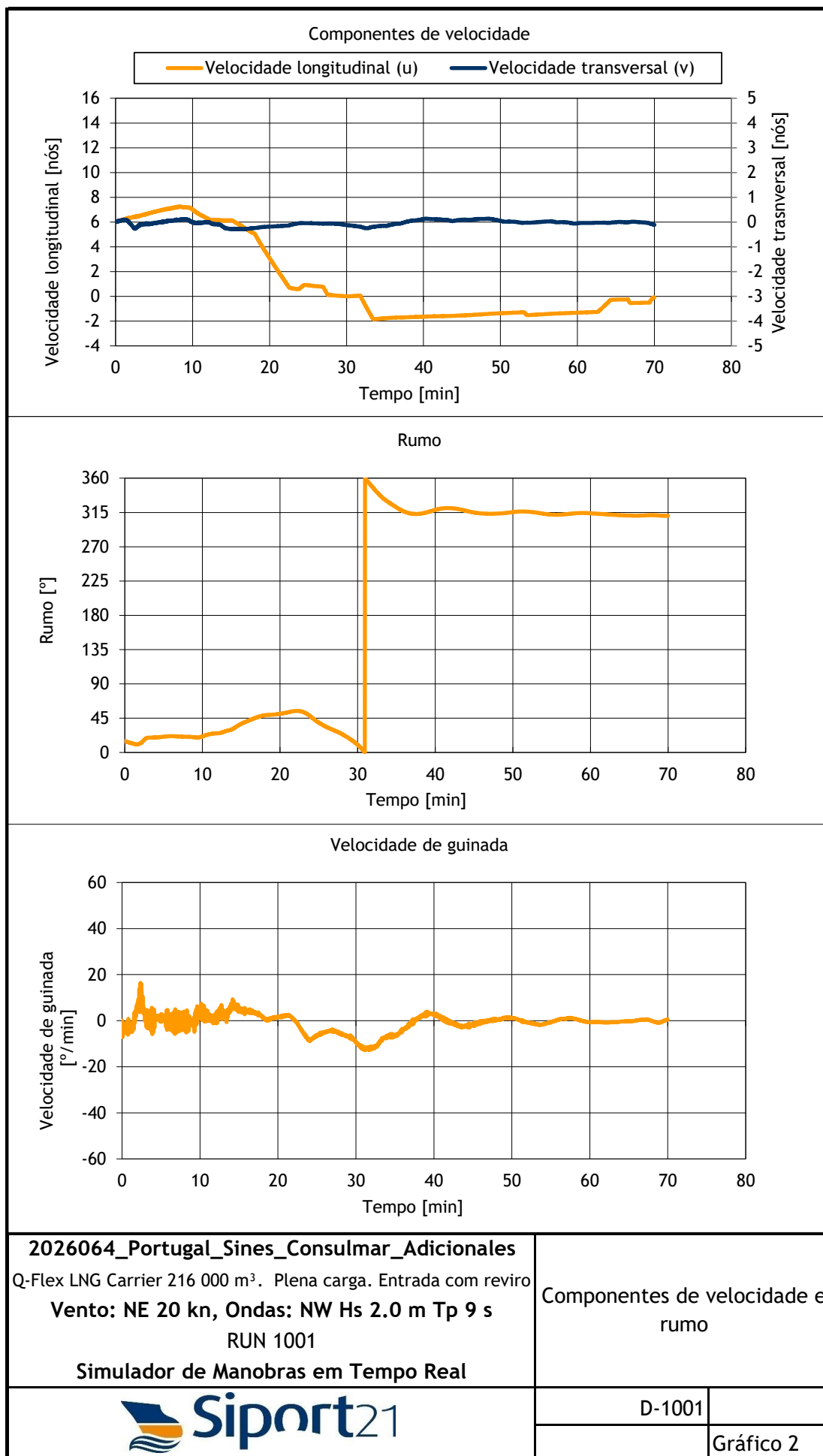
Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

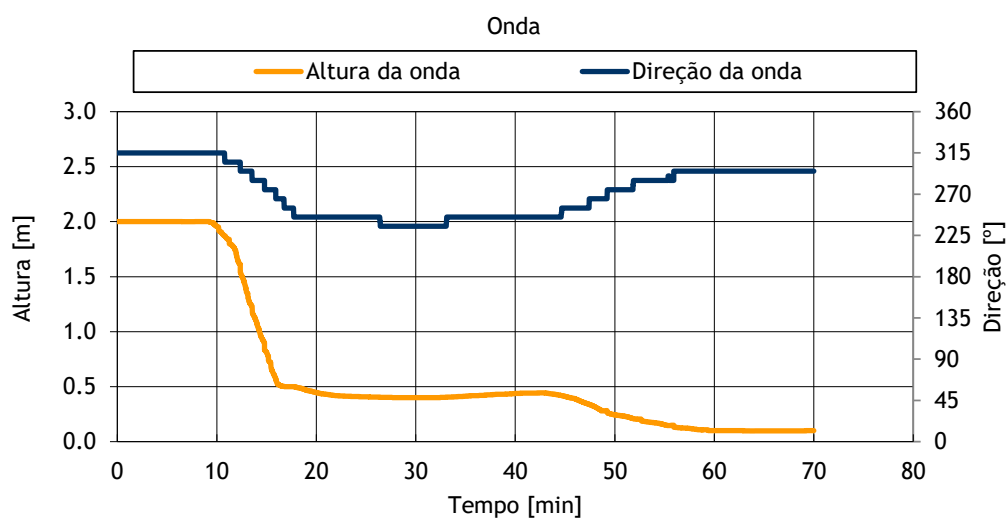
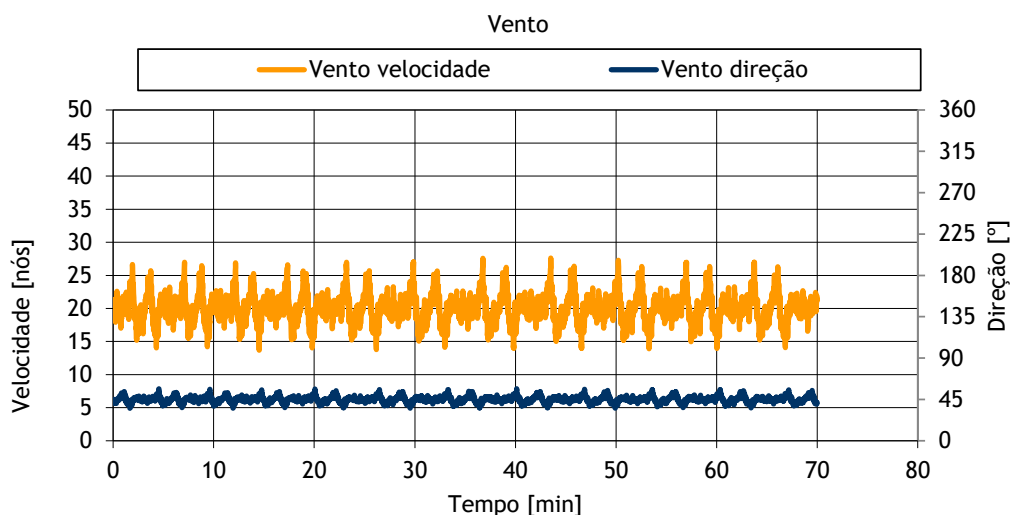
Velocidade, hélice e leme



D-1001

Gráfico 1





2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 1001

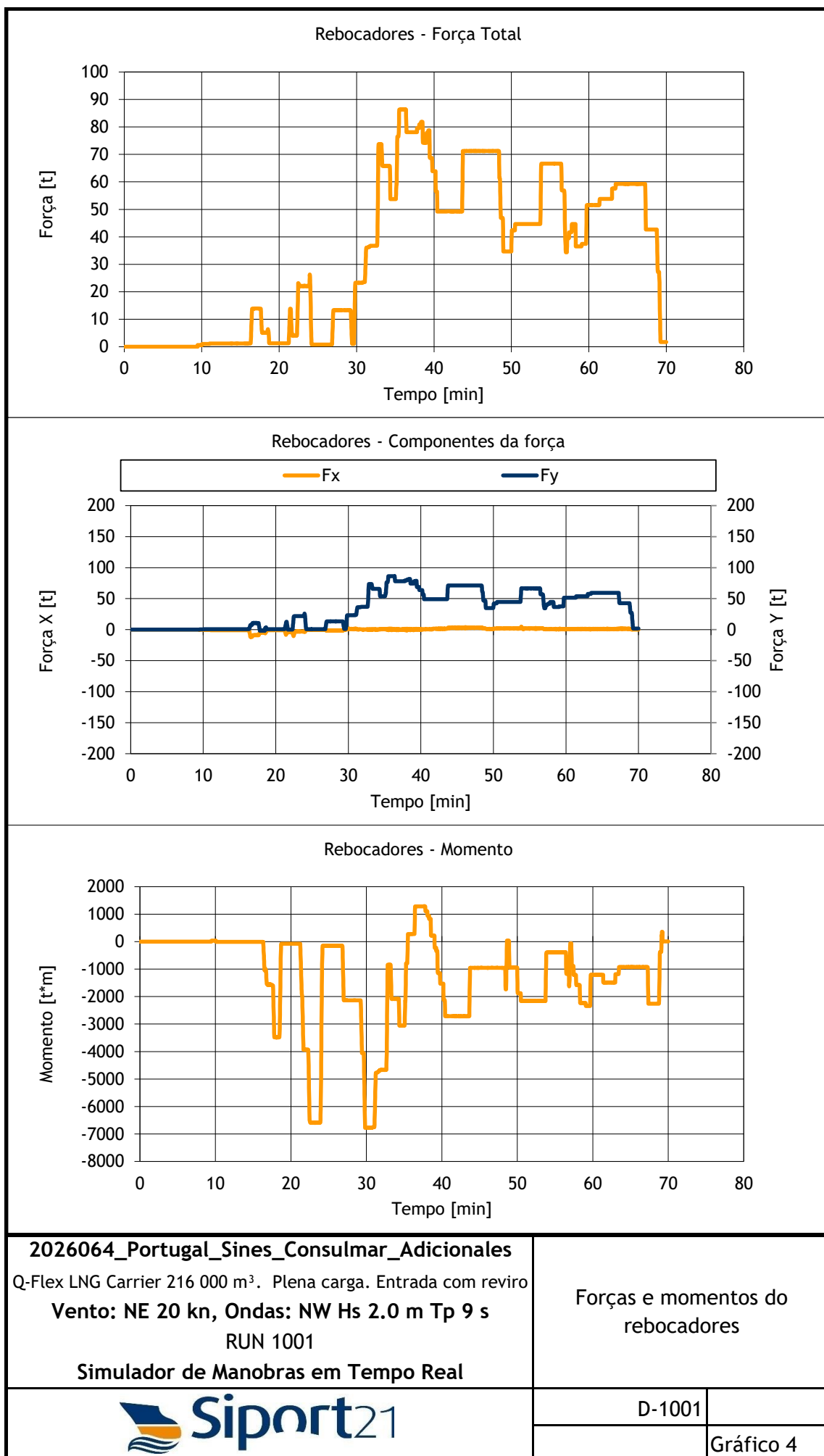
Simulador de Manobras em Tempo Real

Condições climáticas

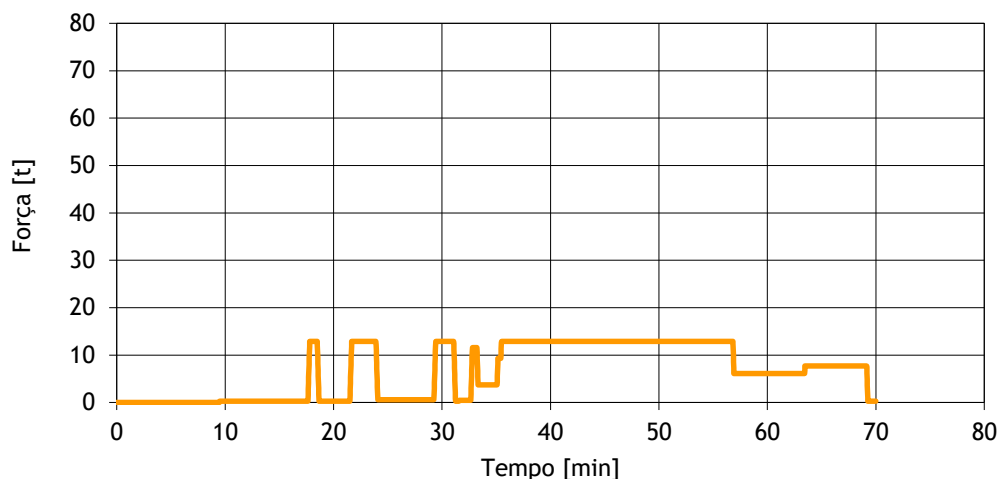


D-1001

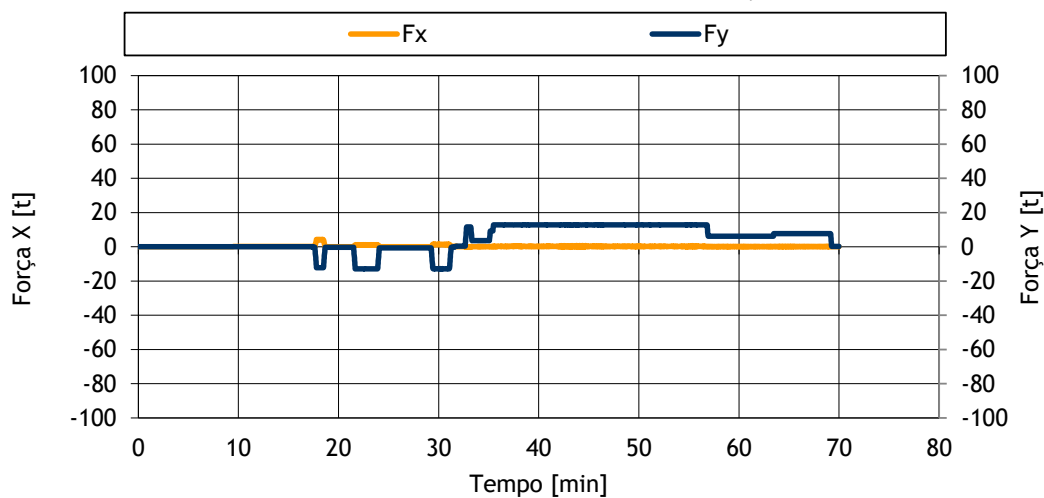
Gráfico 3



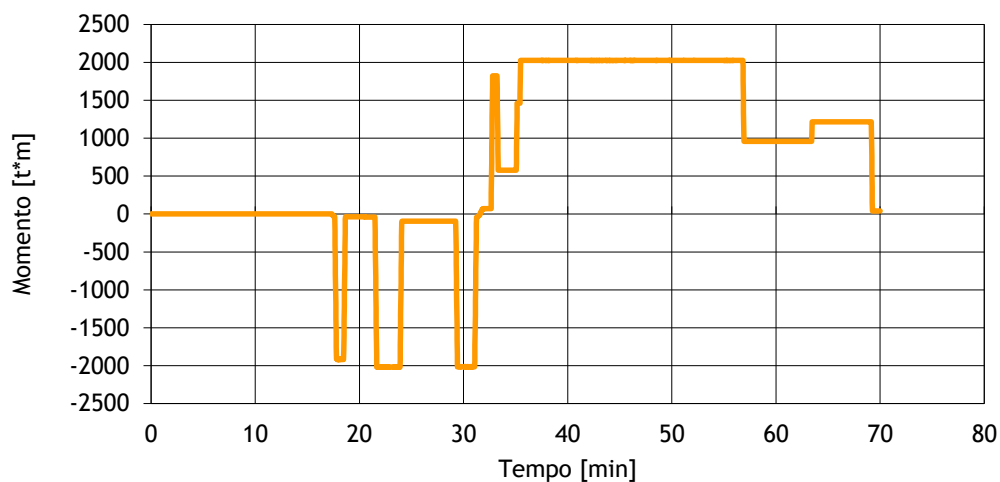
Rebocador 1 (25 t) - Força Total



Rebocador 1 (25 t) - Componentes da força



Rebocador 1 (25 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 1001

Simulador de Manobras em Tempo Real

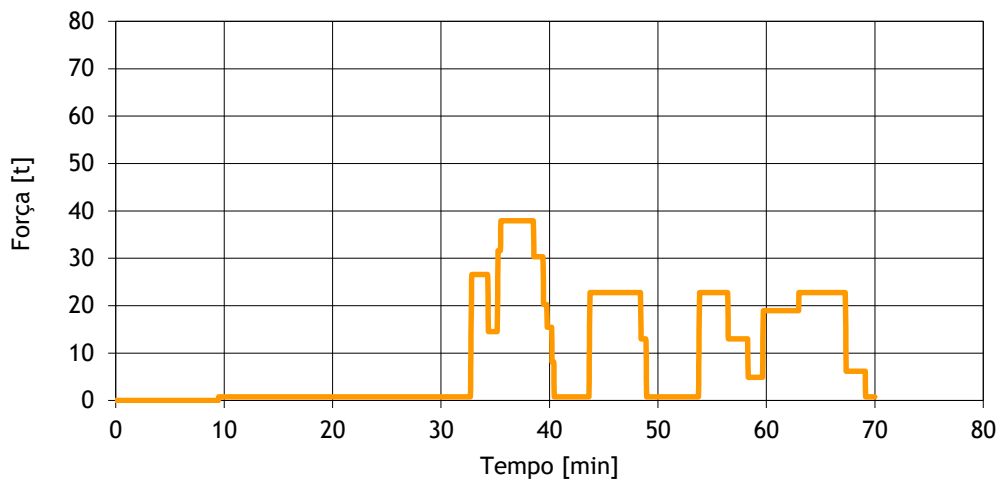
Rebocador 1 (25 t)



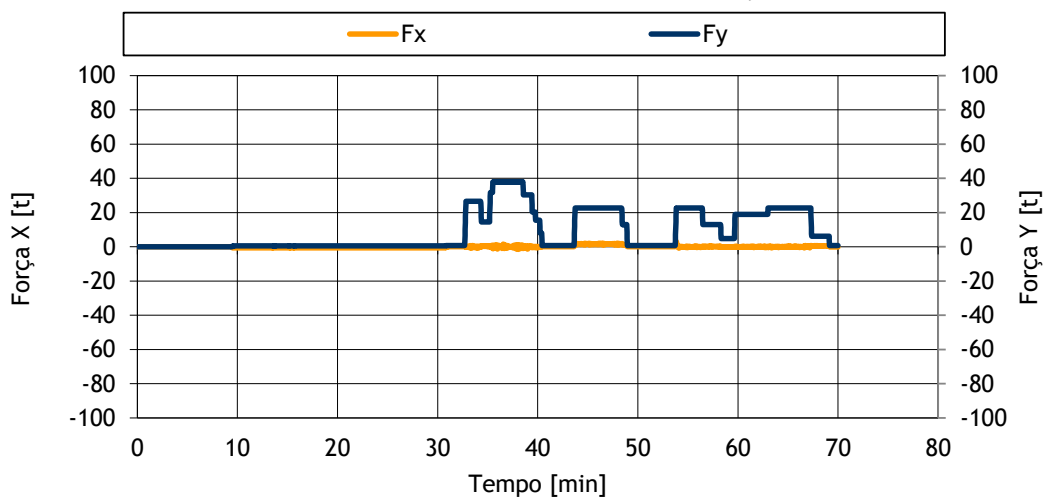
D-1001

Gráfico 5

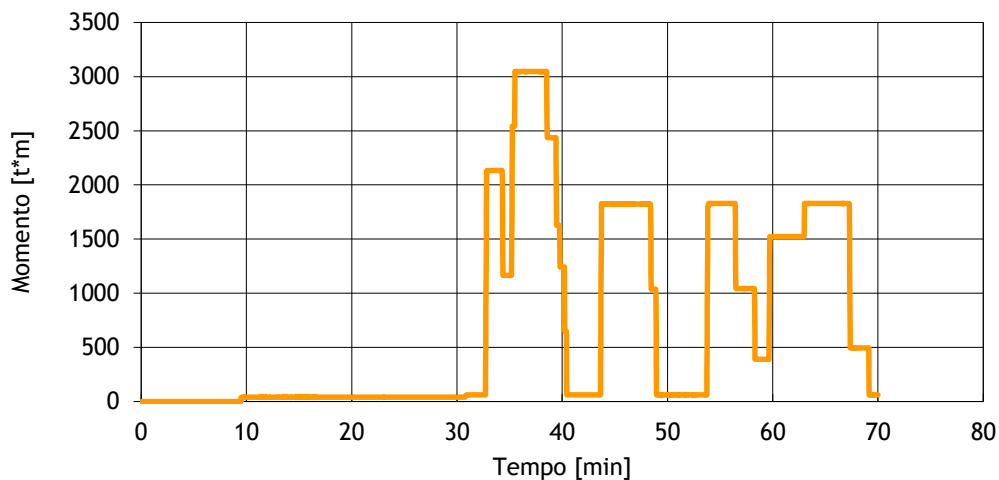
Rebocador 2 (75 t) - Força Total



Rebocador 2 (75 t) - Componentes da força



Rebocador 2 (75 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 1001

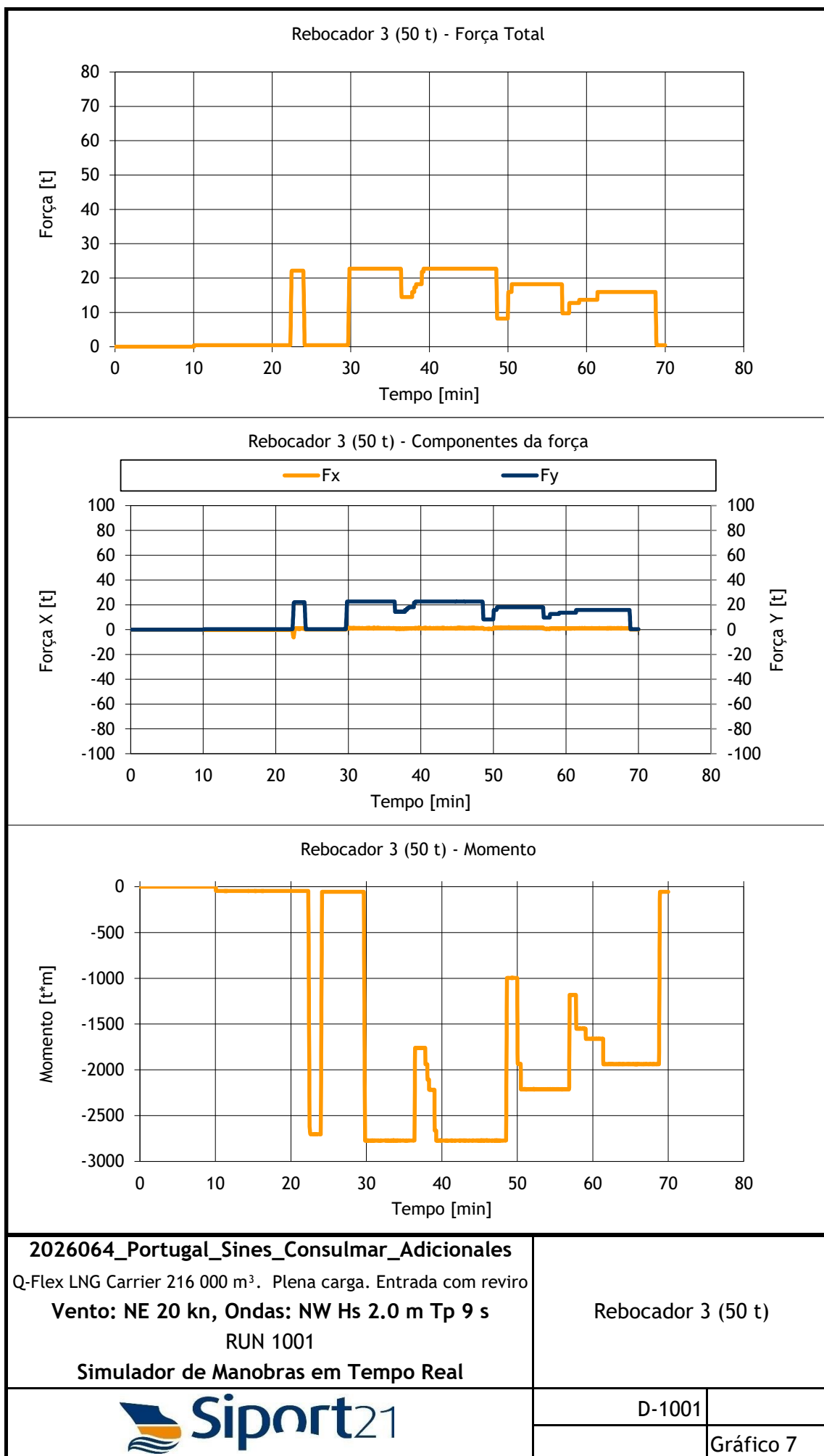
Simulador de Manobras em Tempo Real

Rebocador 2 (75 t)

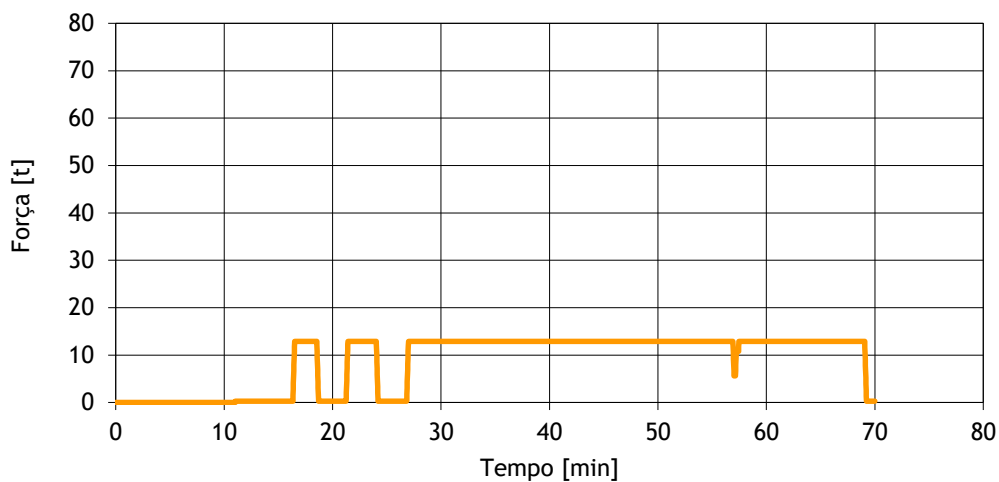


D-1001

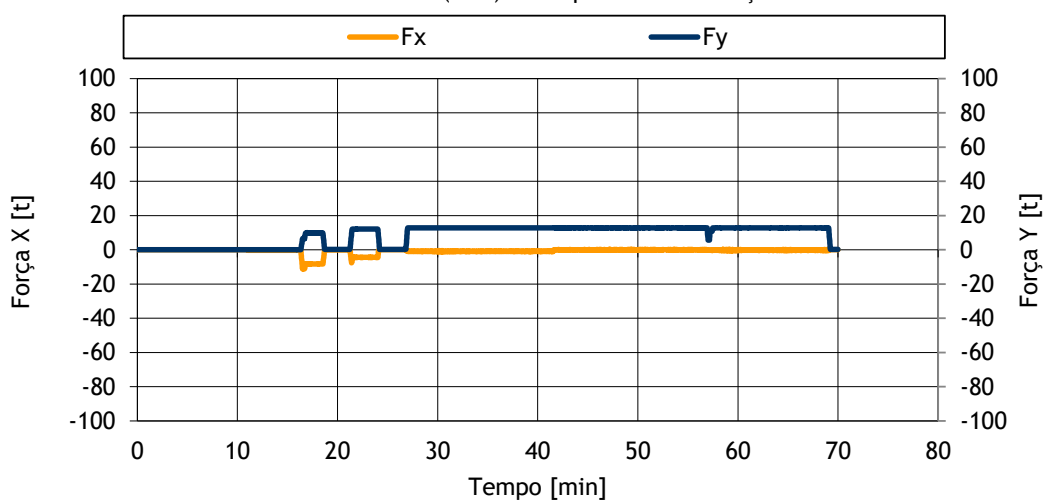
Gráfico 6



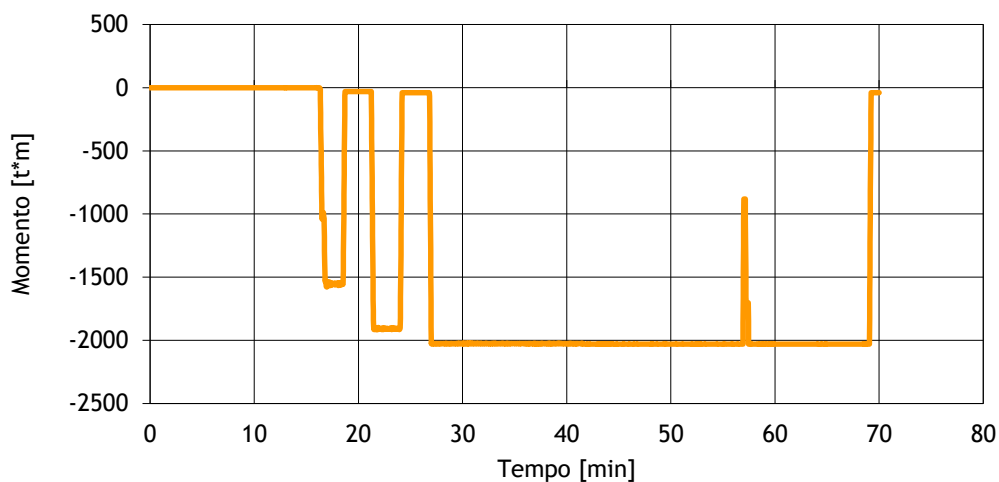
Rebocador 4 (25 t) - Força Total



Rebocador 4 (25 t) - Componentes da força



Rebocador 4 (25 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 1001

Simulador de Manobras em Tempo Real

Rebocador 4 (25 t)



D-1001

Gráfico 8

RUN 2001

**Q-Flex LNG Carrier 216 000 m³. Plena carga.
Entrada com reviro**

Vento: SW 25 kn, Ondas: SW Hs 2.0 m Tp 10 s

Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

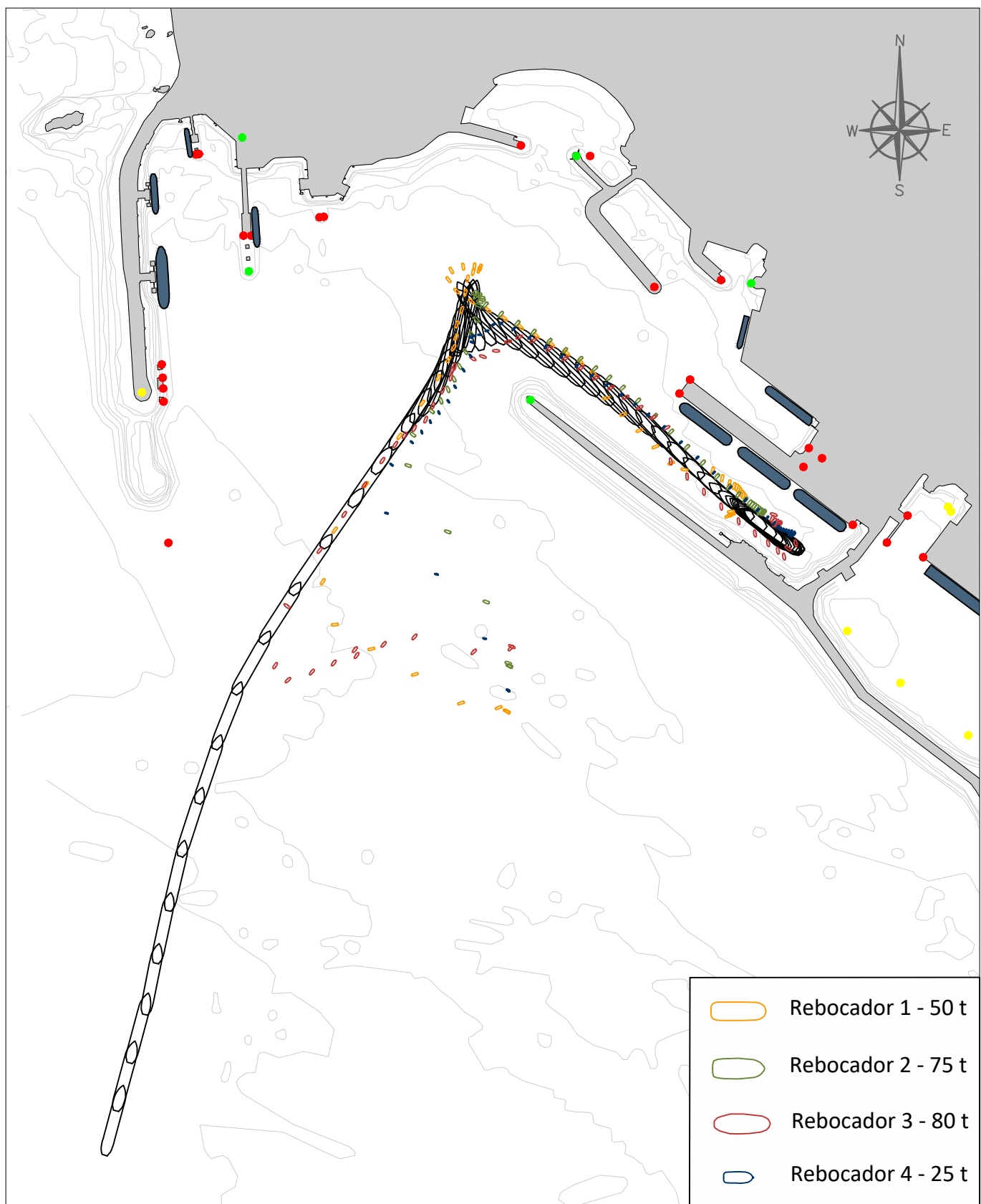


Figure: Trk-2001

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: SW 25 kn, Ondas: SW Hs 2.0 m Tp 10 s

Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 6 000

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales

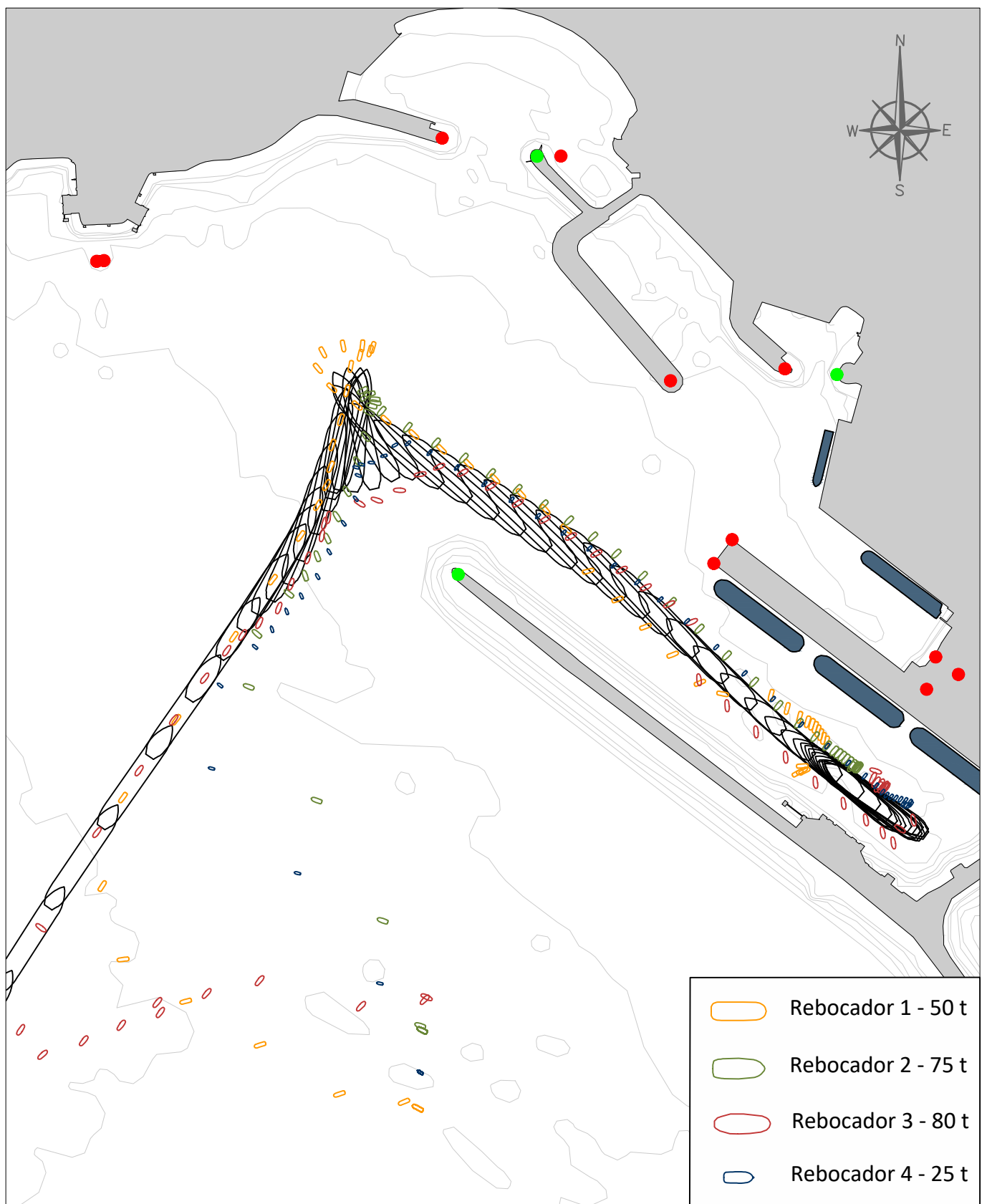


Figure: Trk-2001

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: SW 25 kn, Ondas: SW Hs 2.0 m Tp 10 s

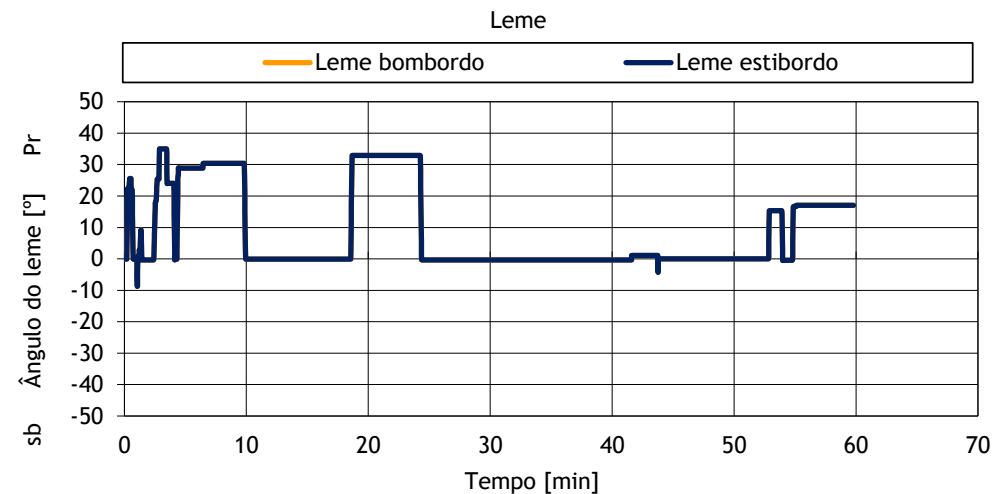
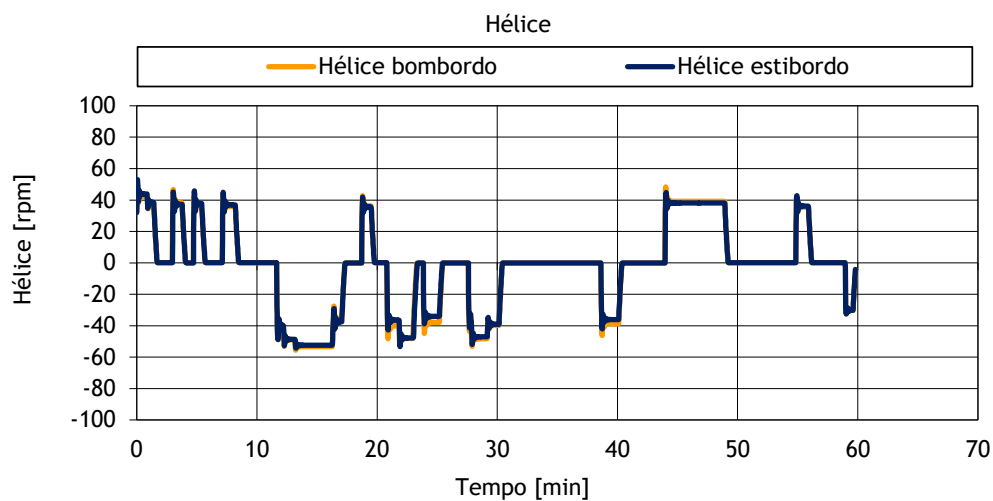
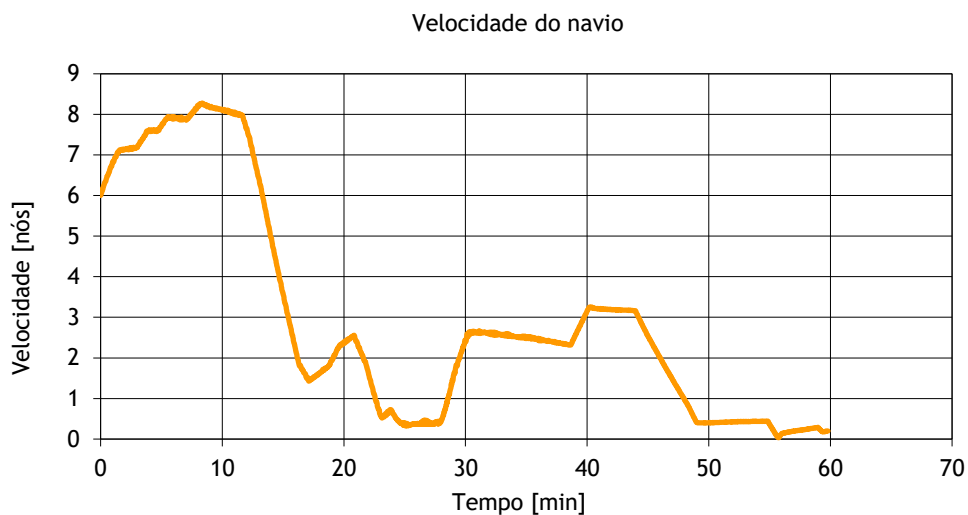
Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 3 500

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: SW 25 kn, Ondas: SW Hs 2.0 m Tp 10 s

RUN 2001

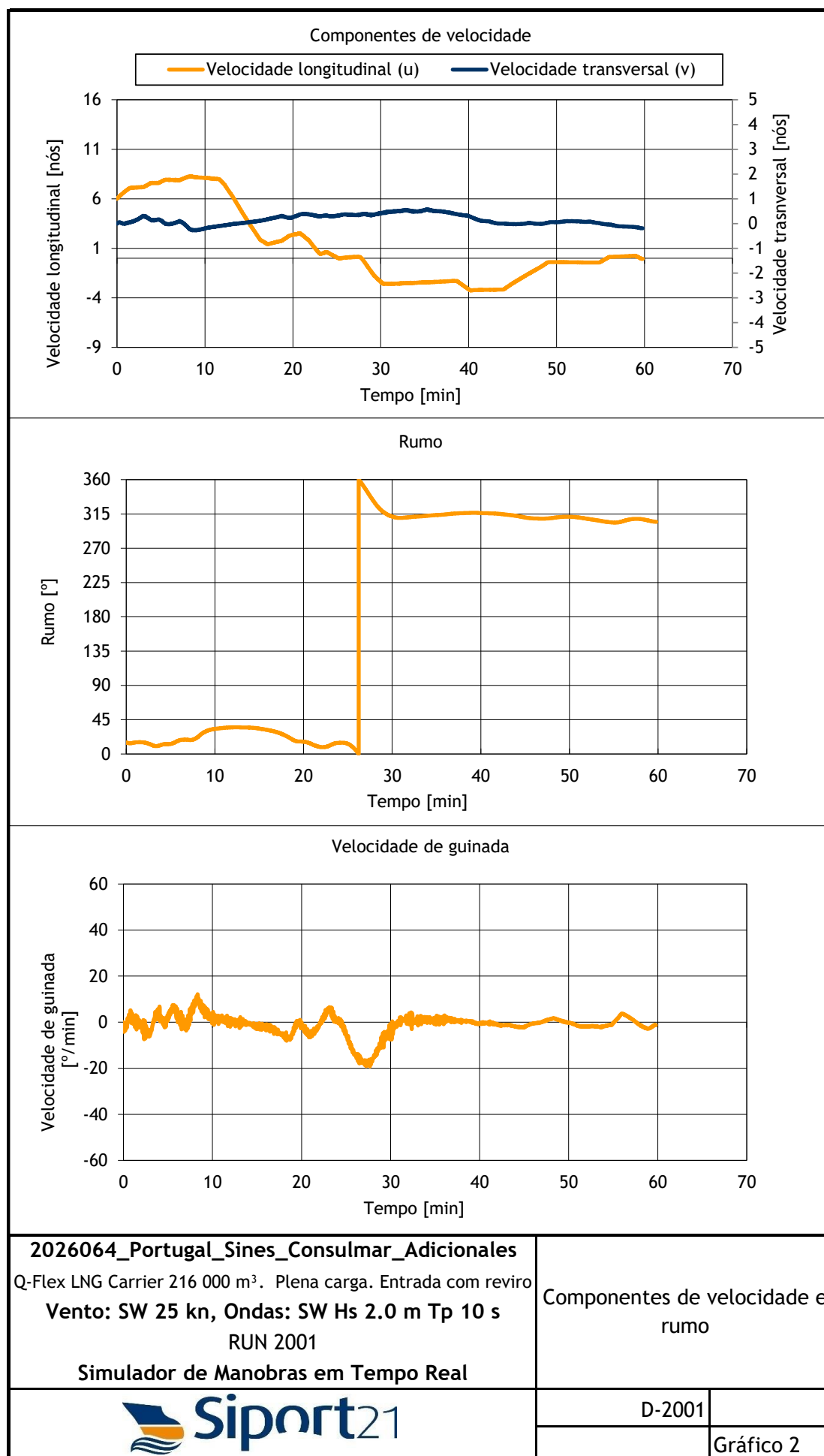
Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

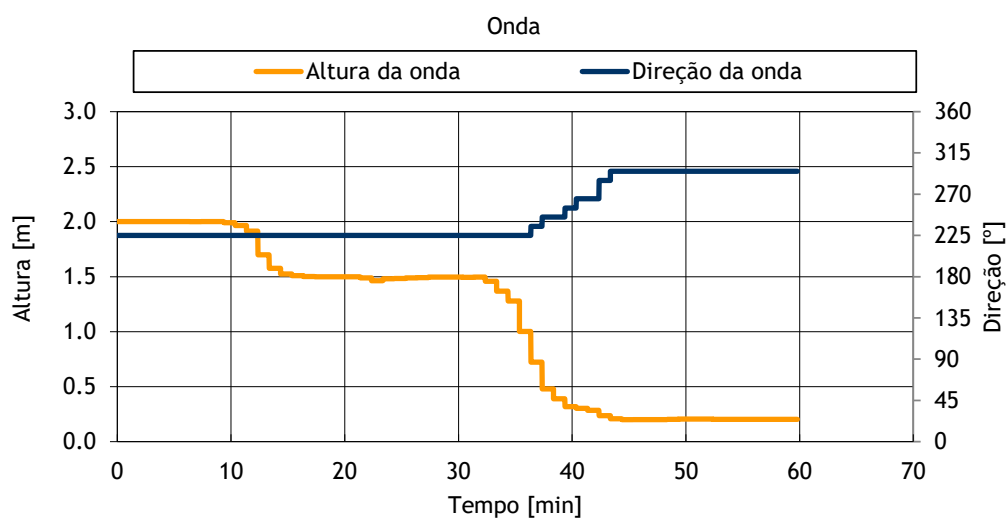
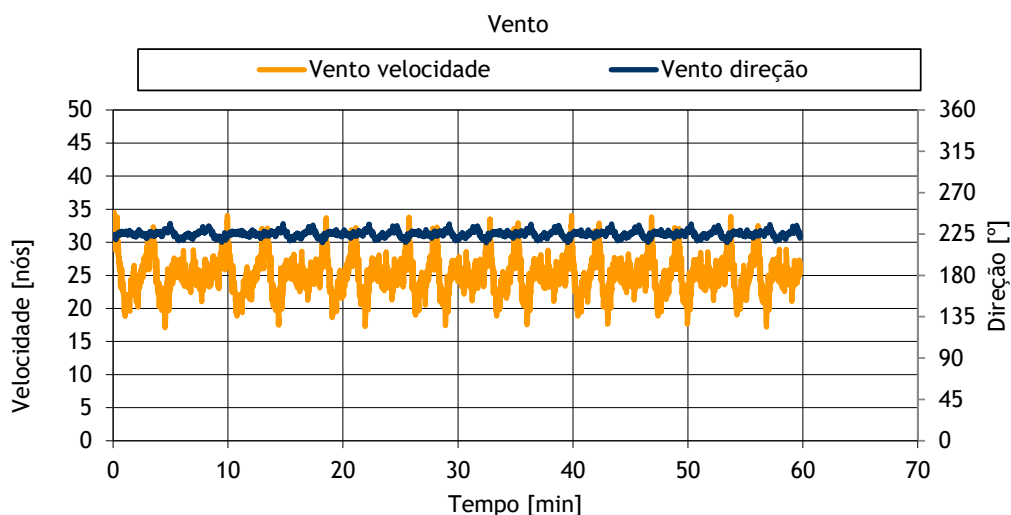
Velocidade, hélice e leme



D-2001

Gráfico 1





2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: SW 25 kn, Ondas: SW Hs 2.0 m Tp 10 s

RUN 2001

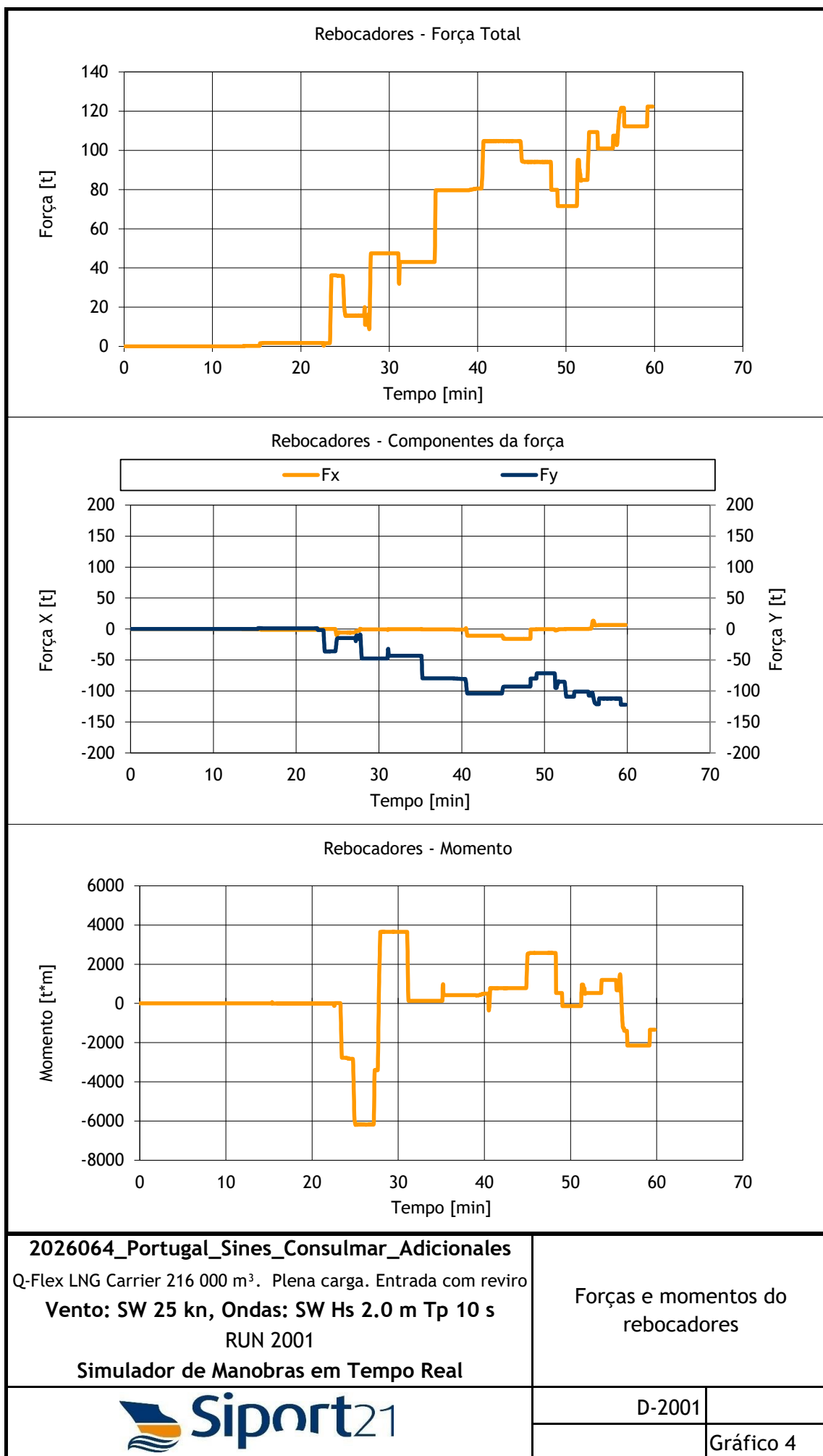
Simulador de Manobras em Tempo Real

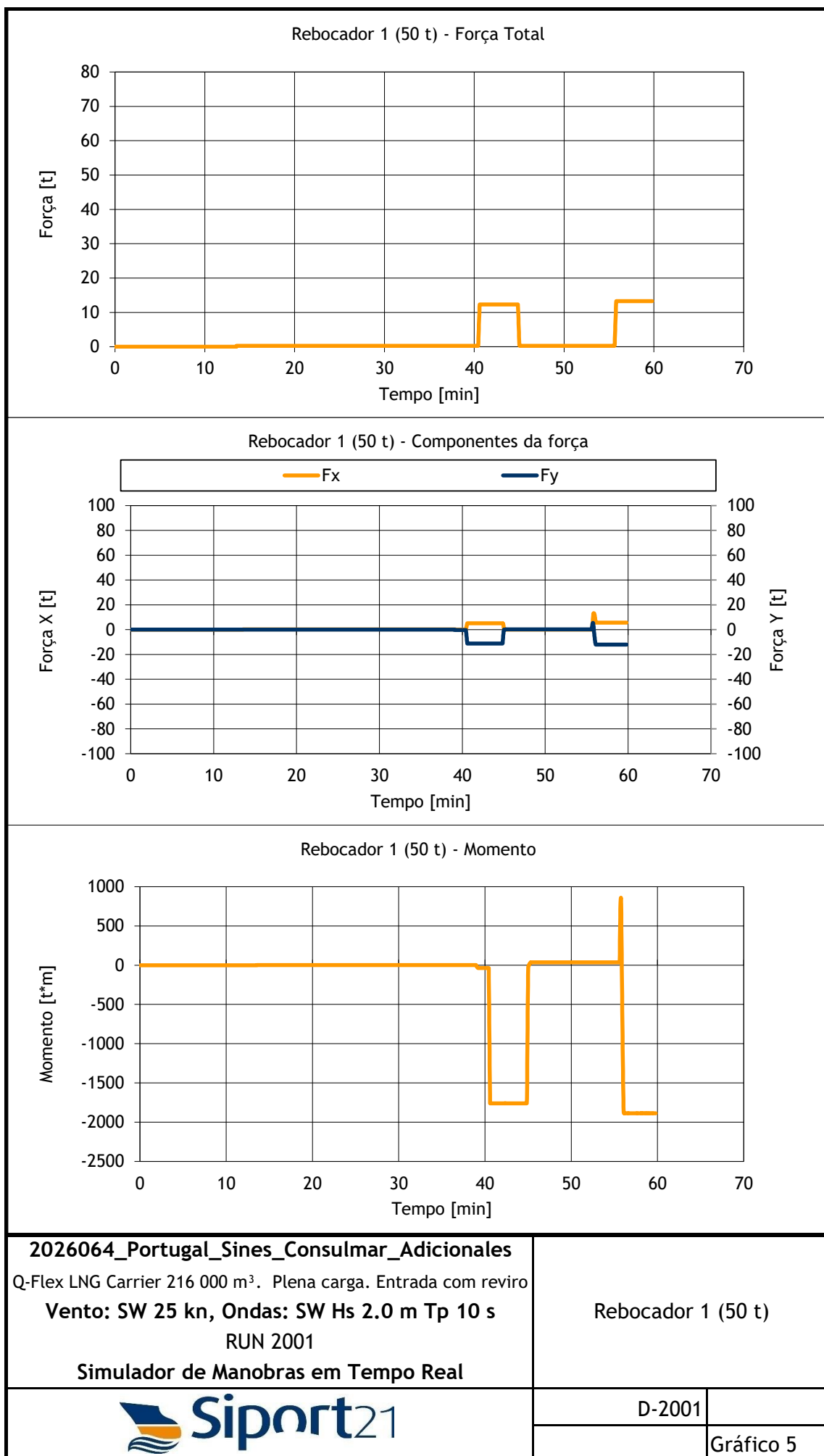
Condições climáticas

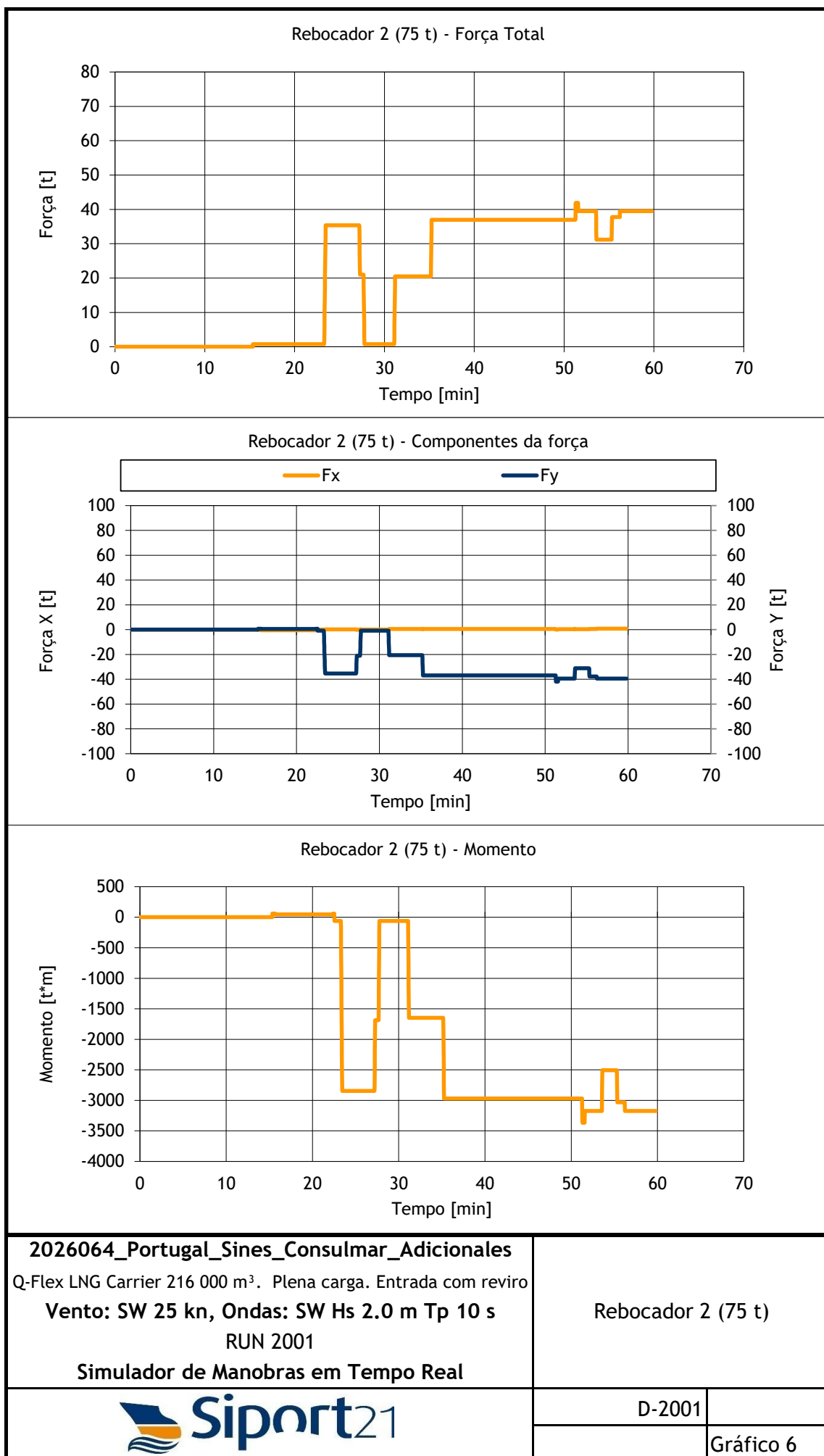


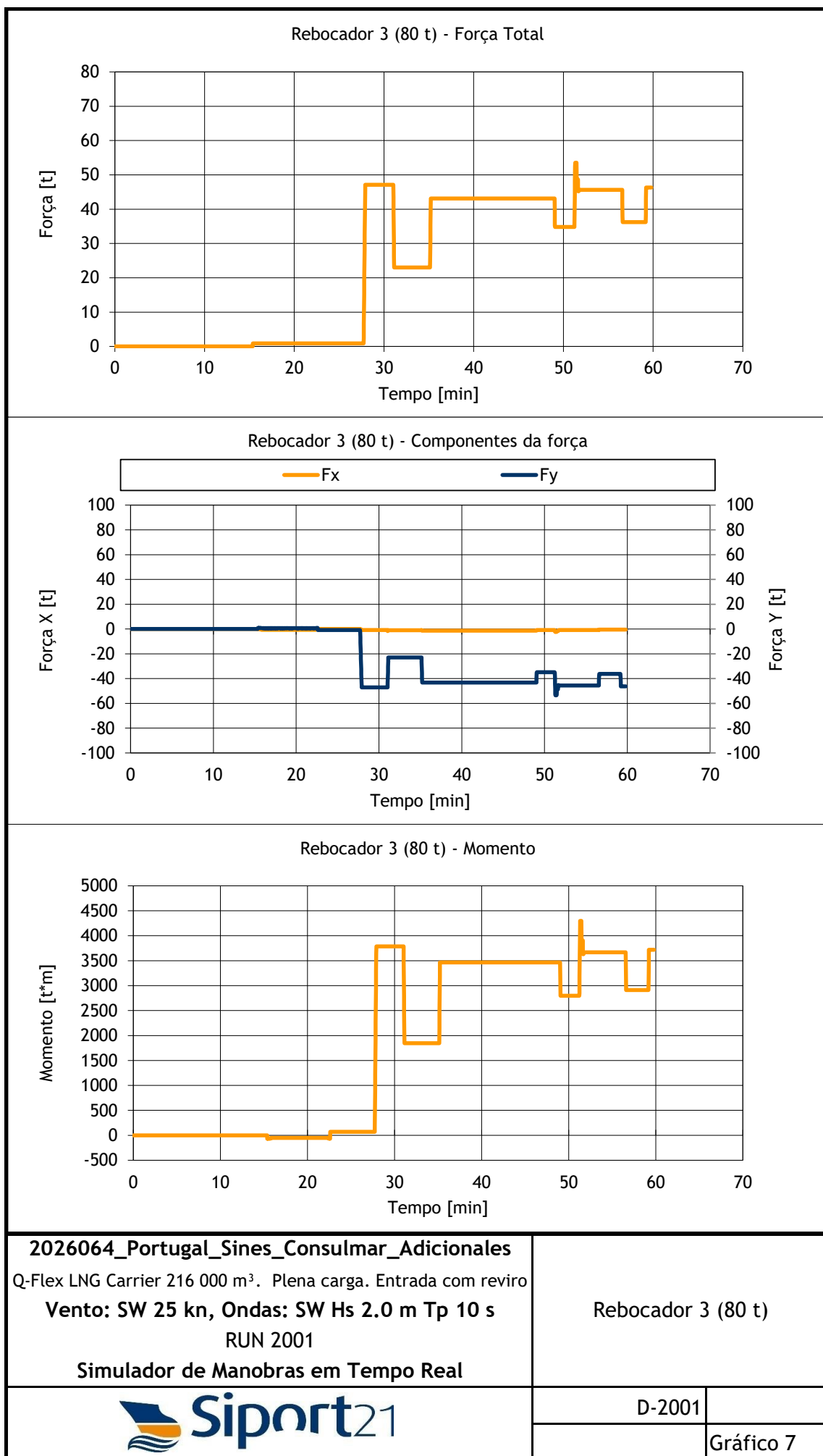
D-2001

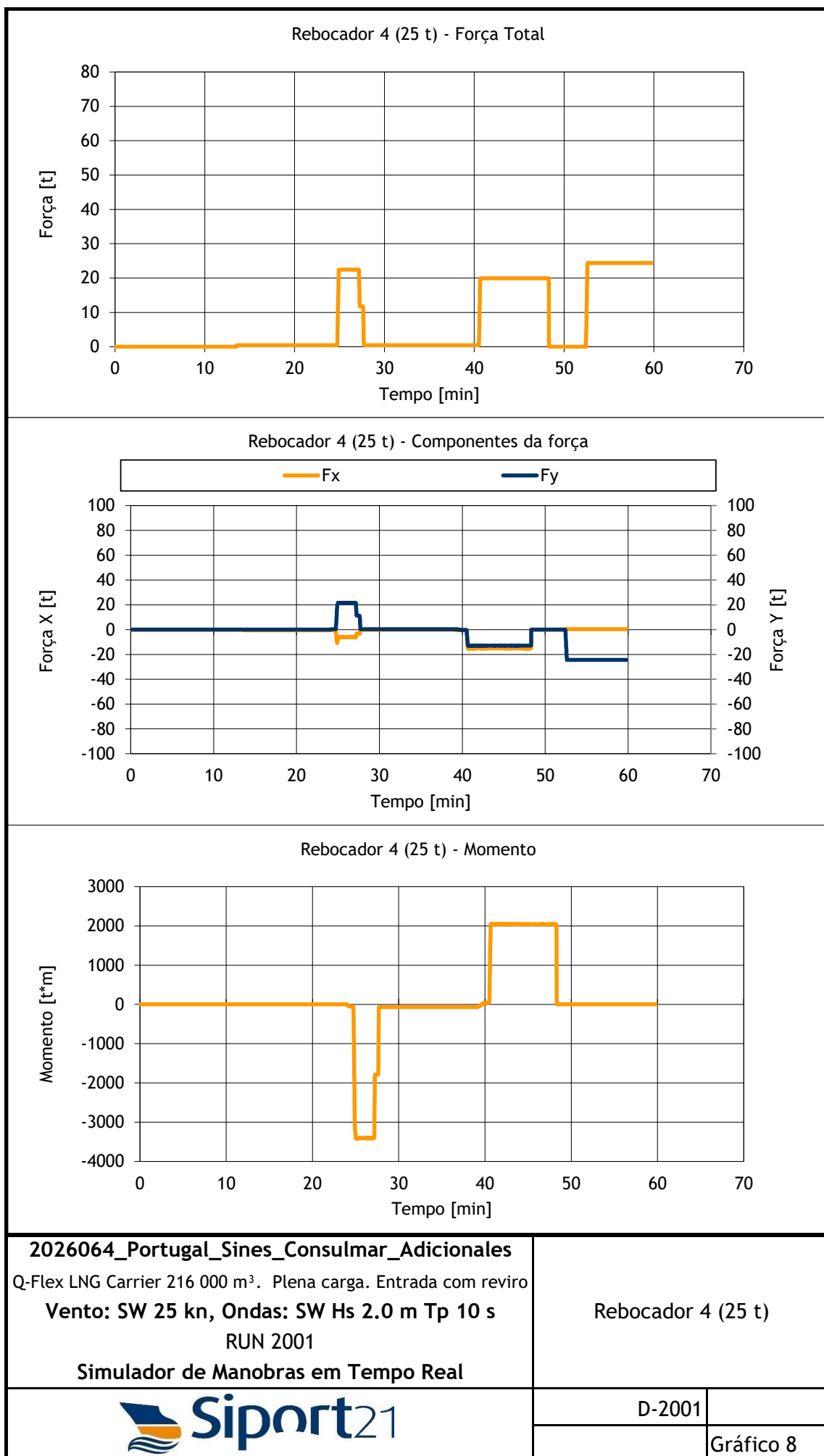
Gráfico 3











RUN 3001

**Q-Flex LNG Carrier 216 000 m³. Lastro. Saída
direta**

Vento: NW 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

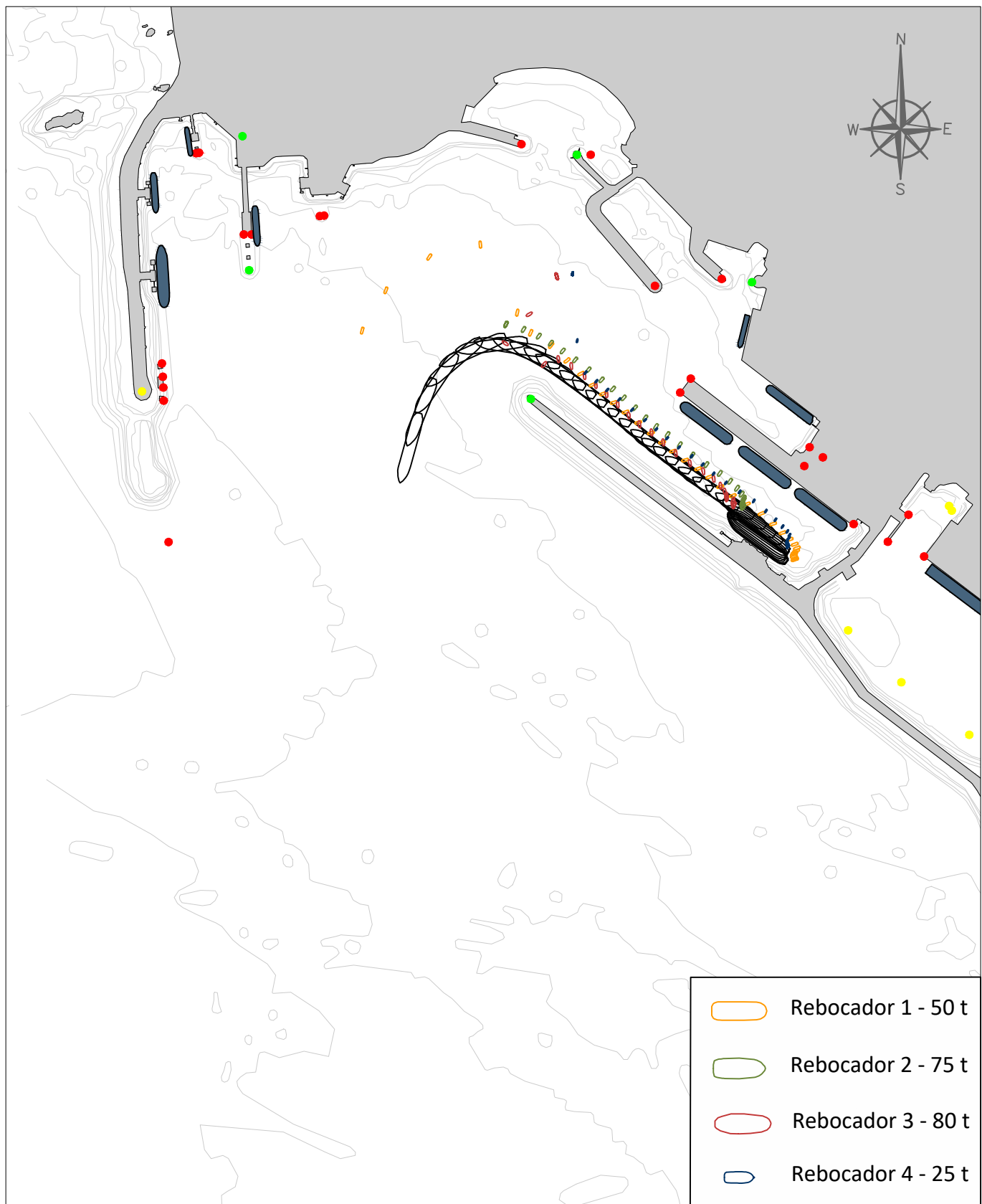


Figure: Trk-3001

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NW 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 6 000

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales

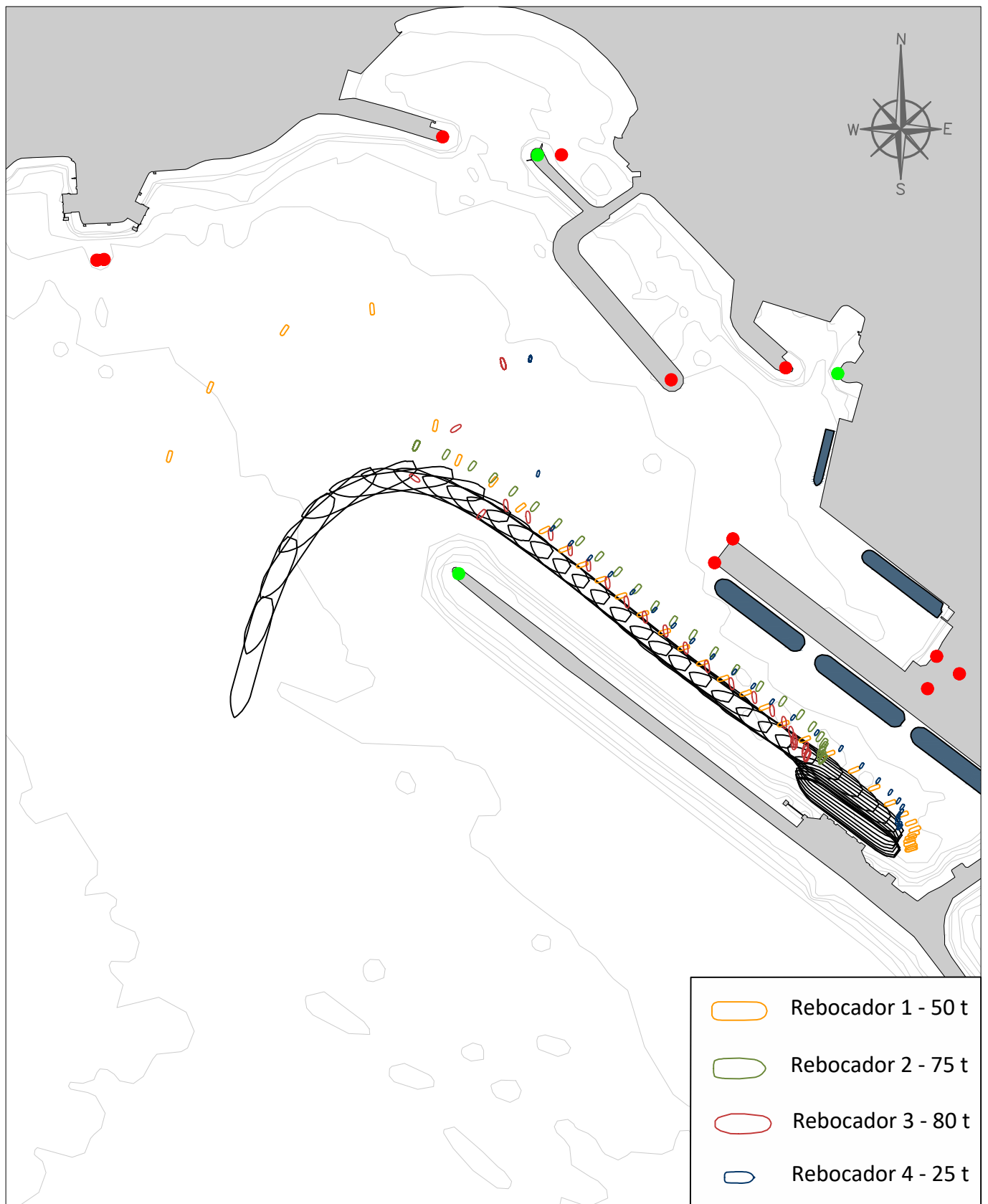


Figure: Trk-3001

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NW 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

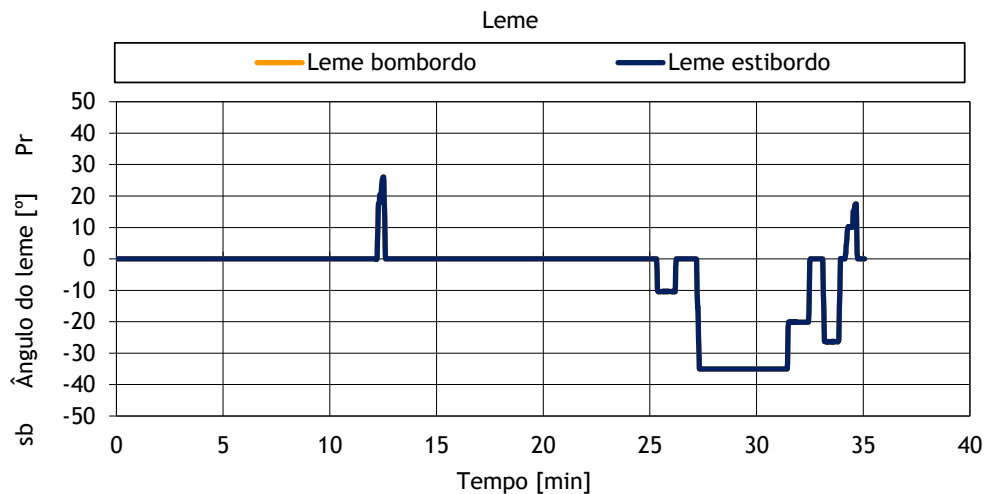
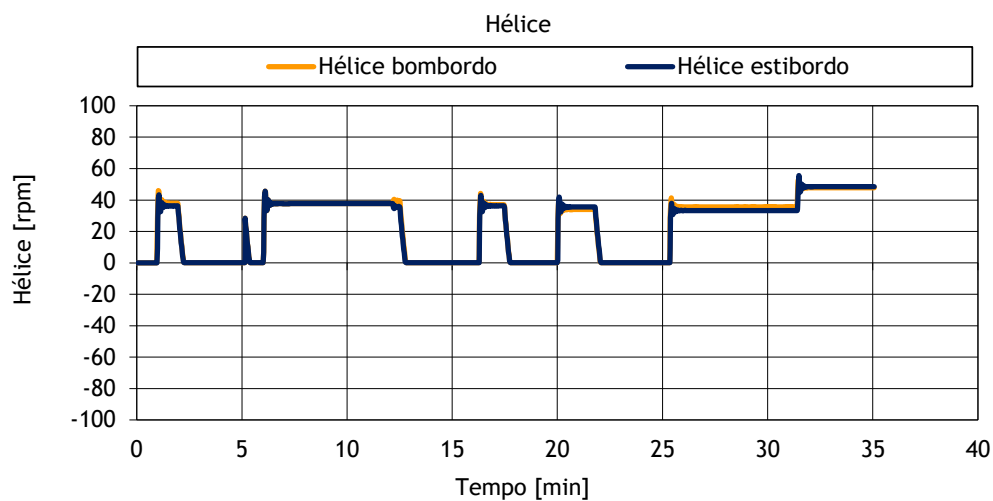
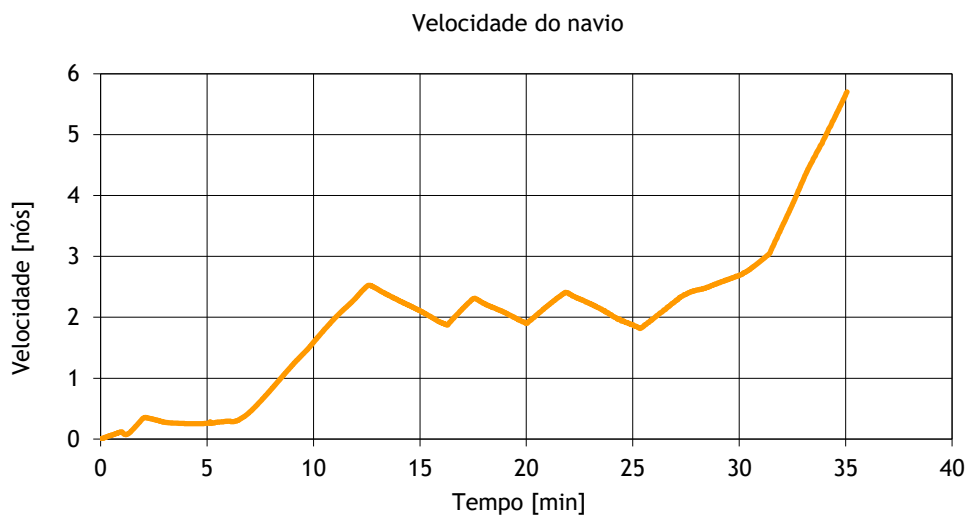
Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 3 500

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales



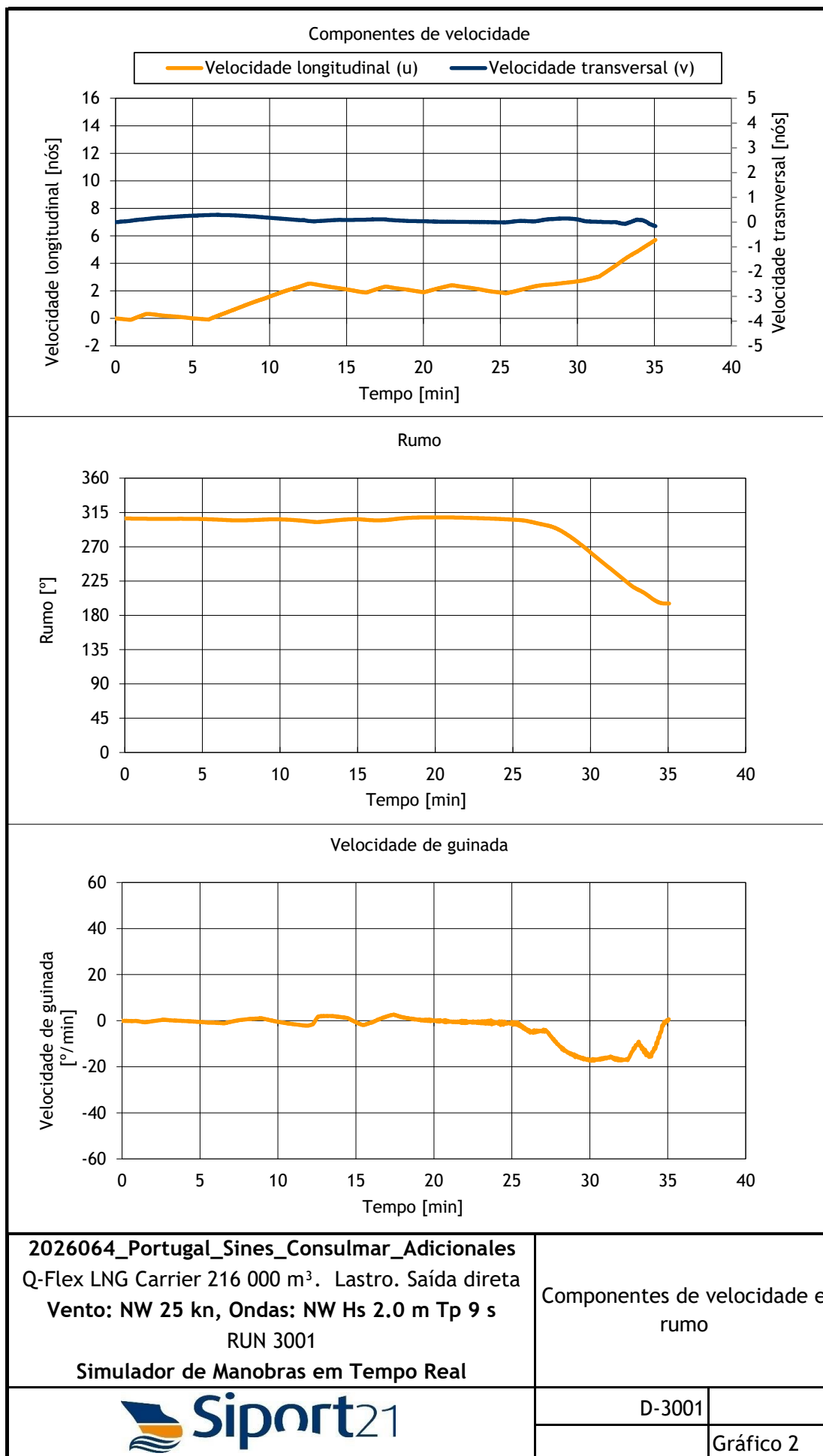
2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
 Vento: NW 25 kn, Ondas: NW Hs 2.0 m Tp 9 s
 RUN 3001
 Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

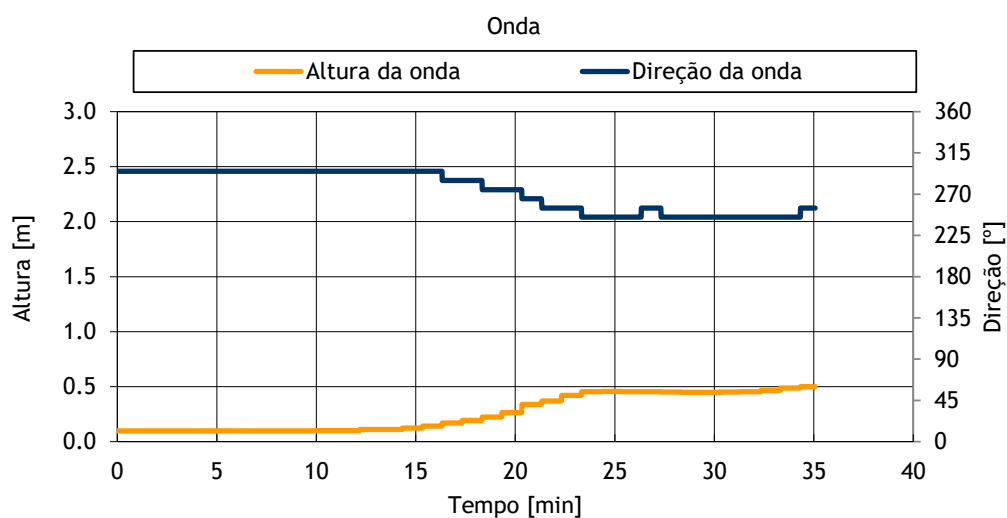
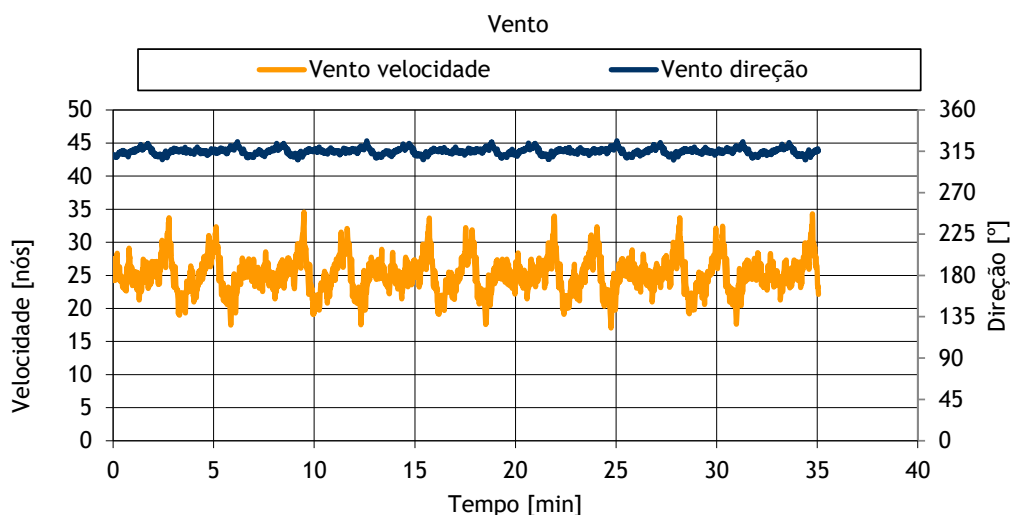
Velocidade, hélice e leme



D-3001

Gráfico 1





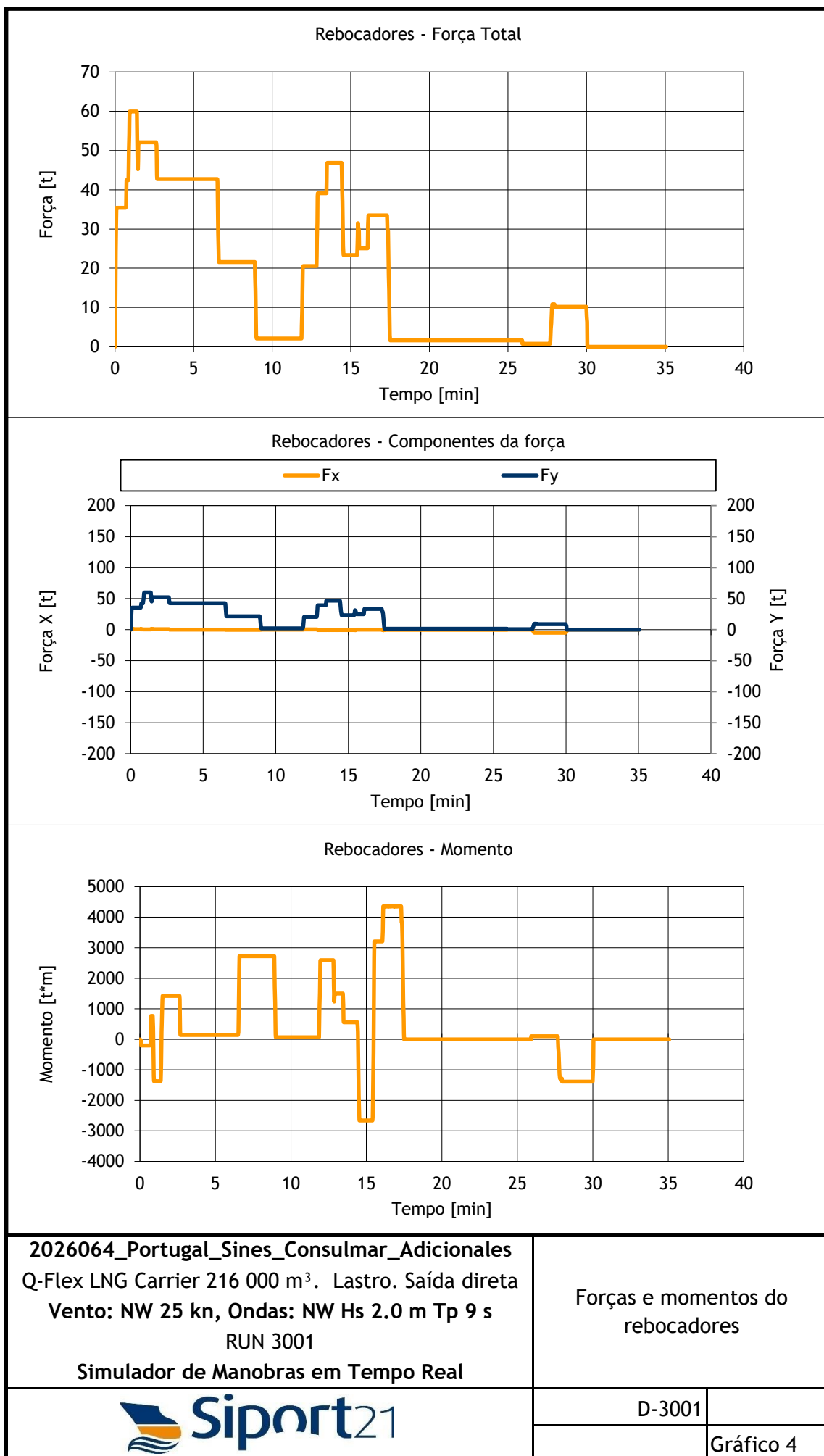
2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
Vento: NW 25 kn, Ondas: NW Hs 2.0 m Tp 9 s
 RUN 3001
 Simulador de Manobras em Tempo Real

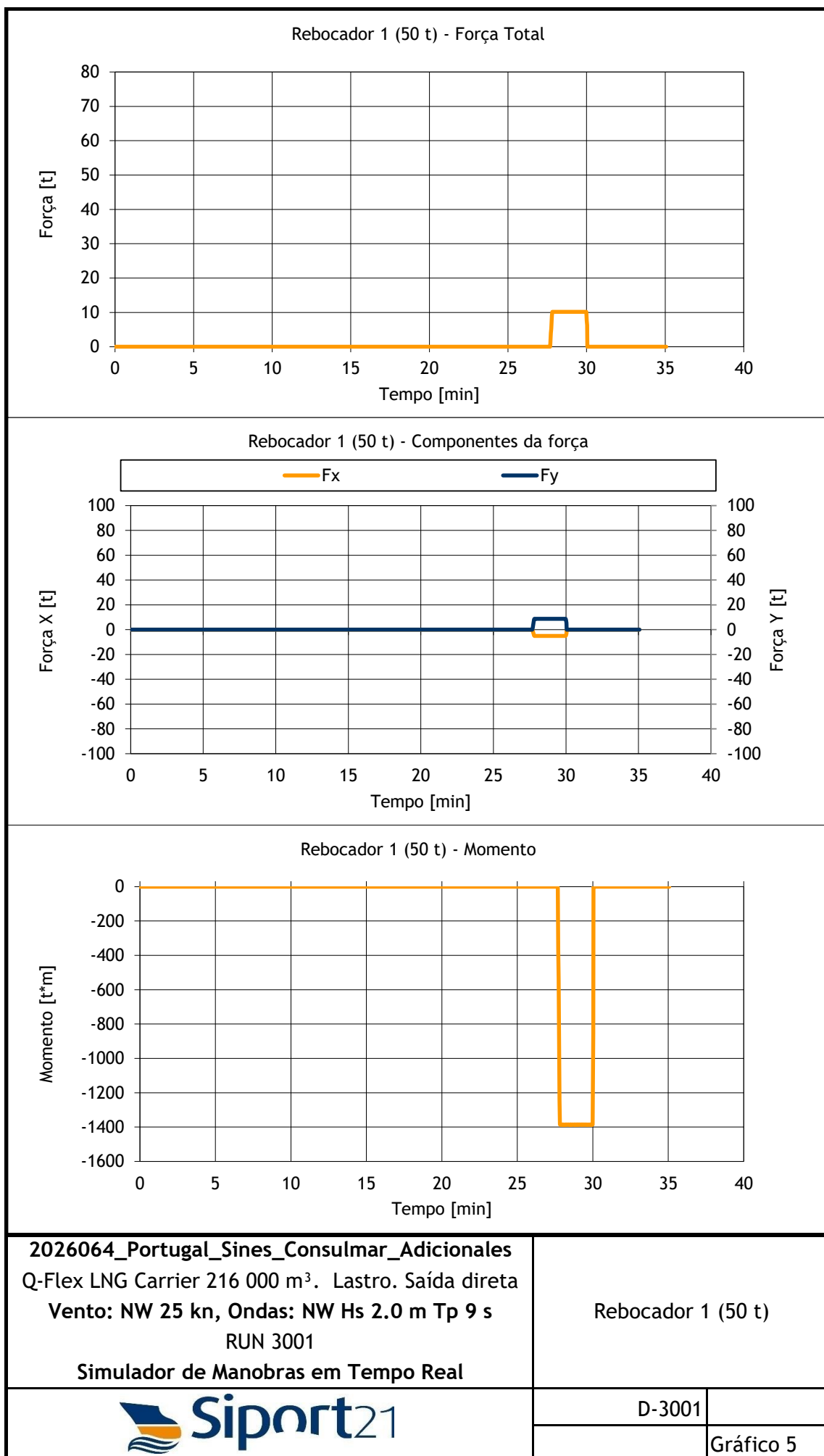
Condições climáticas



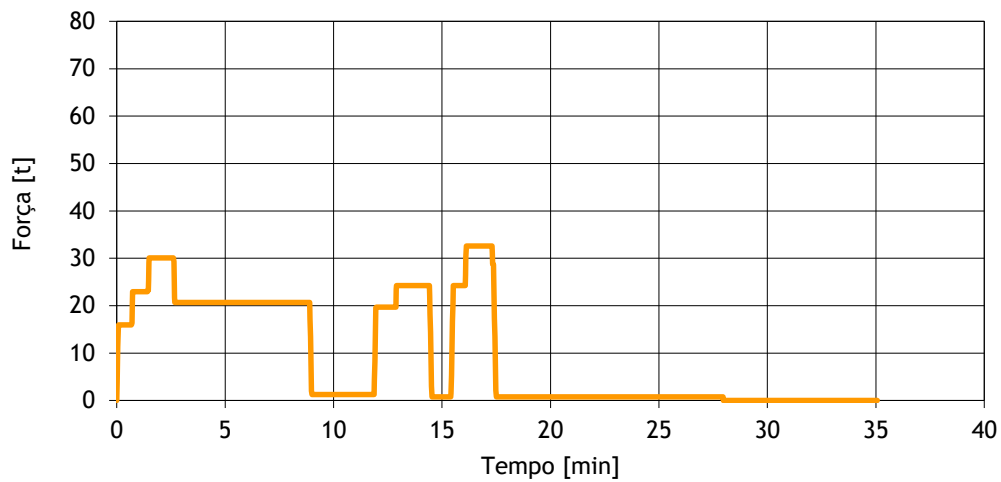
D-3001

Gráfico 3

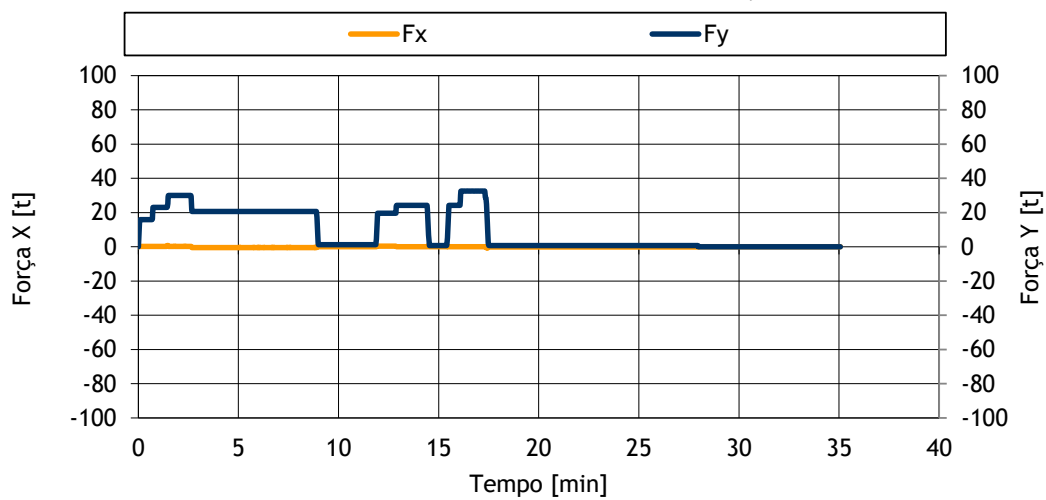




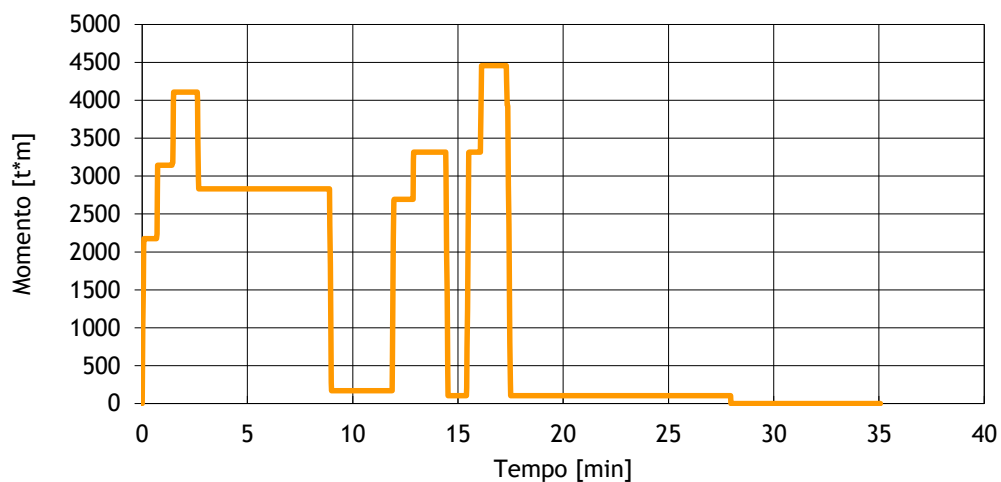
Rebocador 2 (75 t) - Força Total



Rebocador 2 (75 t) - Componentes da força



Rebocador 2 (75 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NW 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 3001

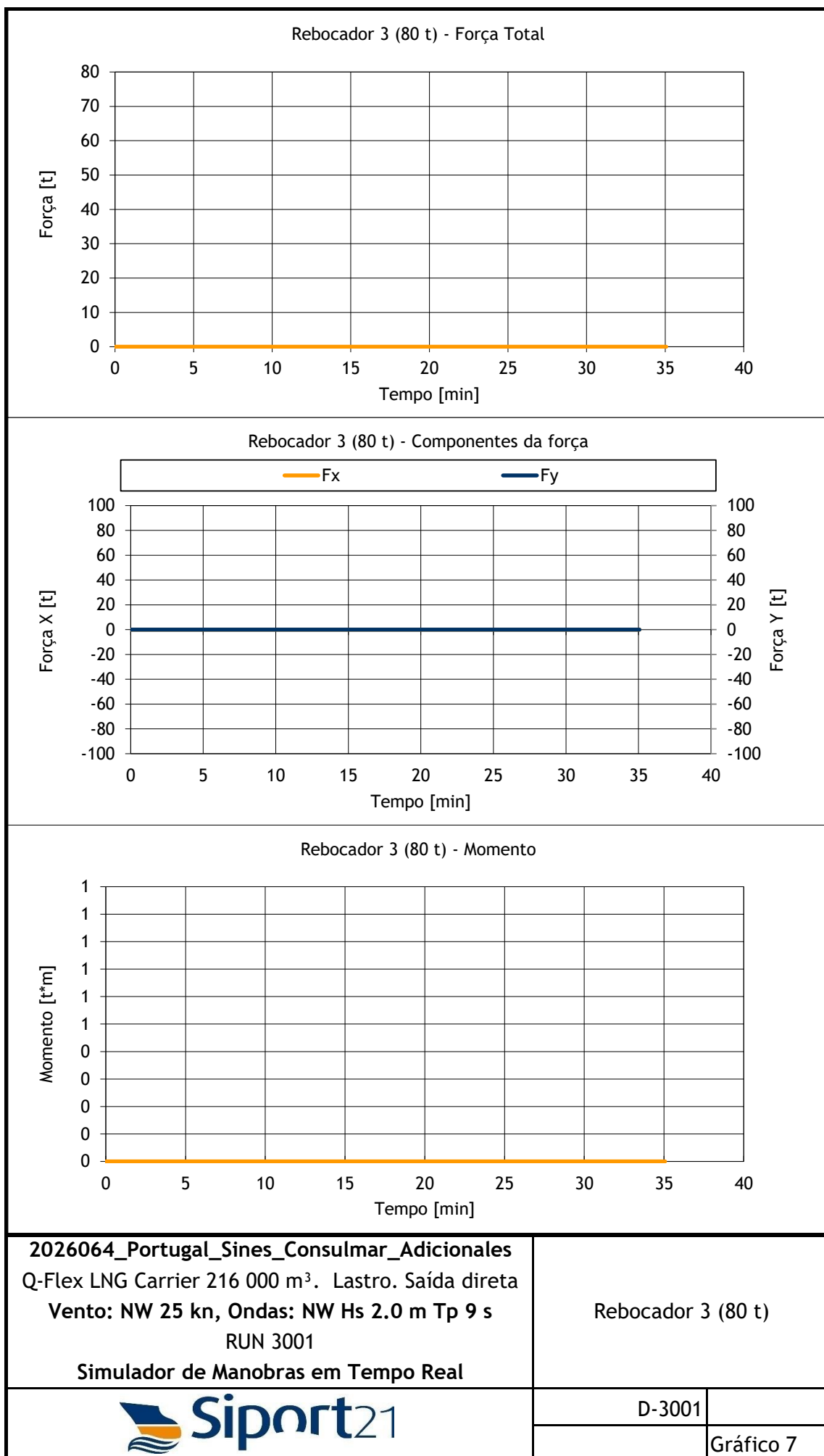
Simulador de Manobras em Tempo Real

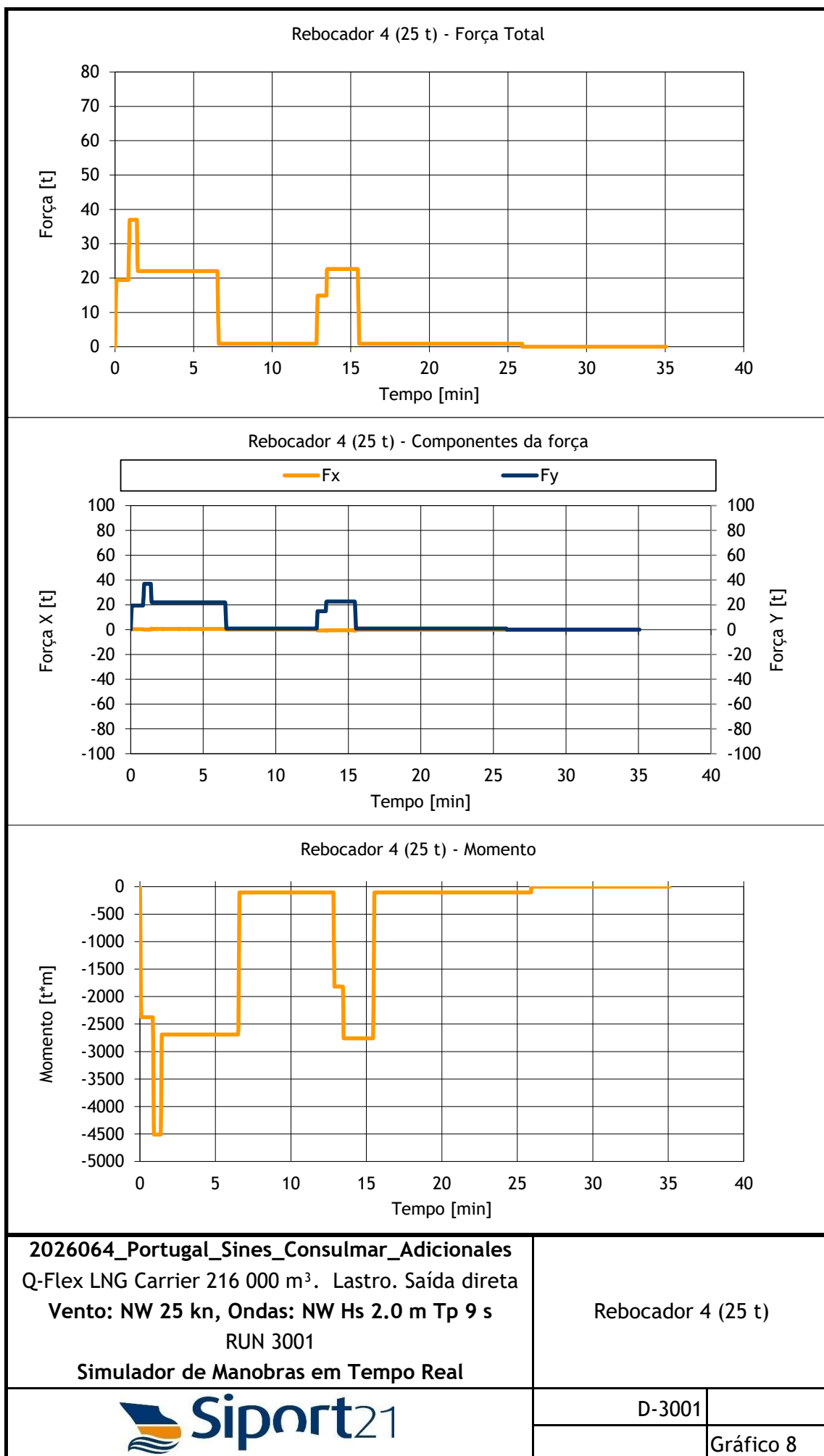
Rebocador 2 (75 t)



D-3001

Gráfico 6





RUN 1002

**Q-Flex LNG Carrier 216 000 m³. Plena carga.
Entrada com reviro**

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

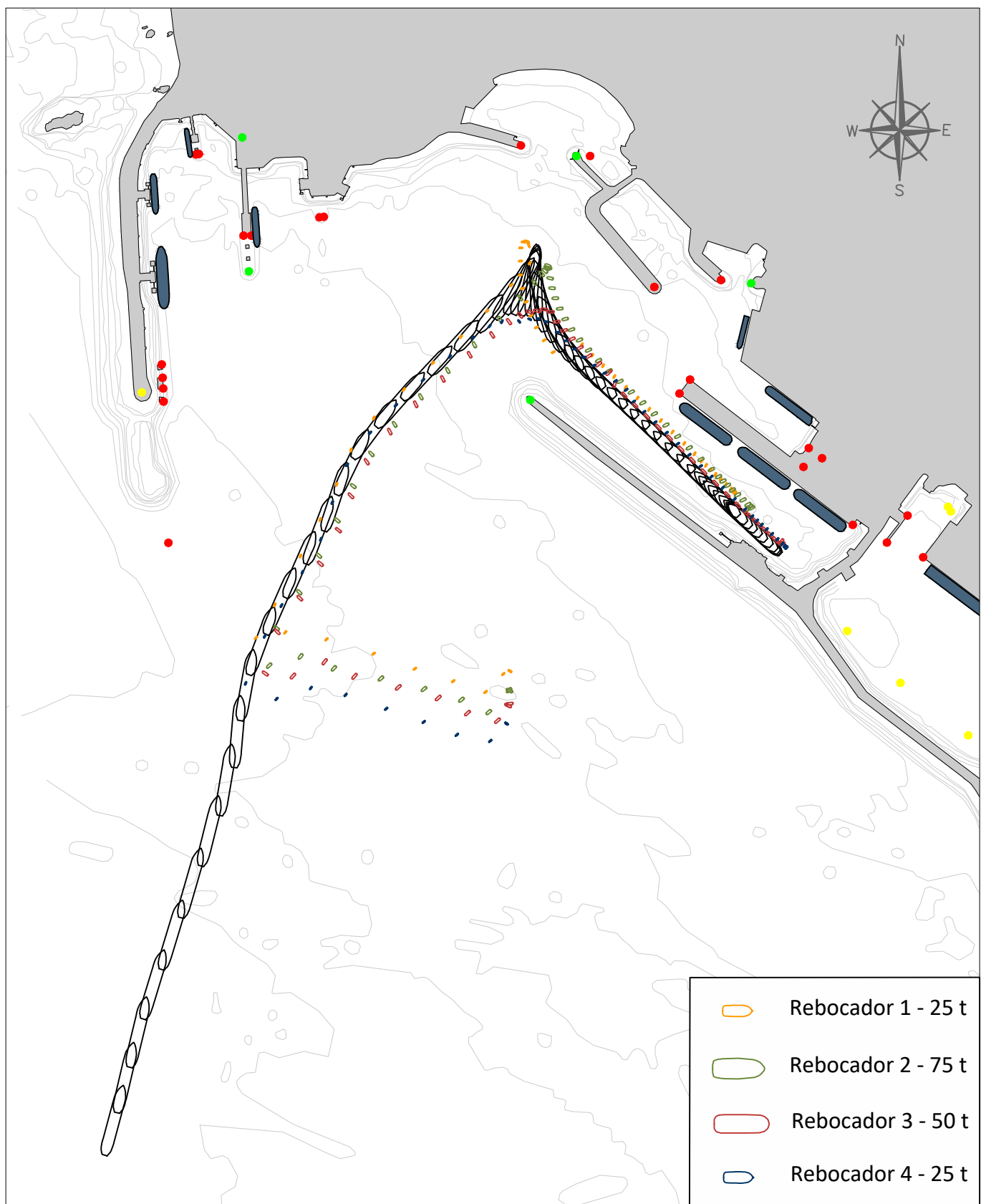


Figure: Trk-1002

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 6 000

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales

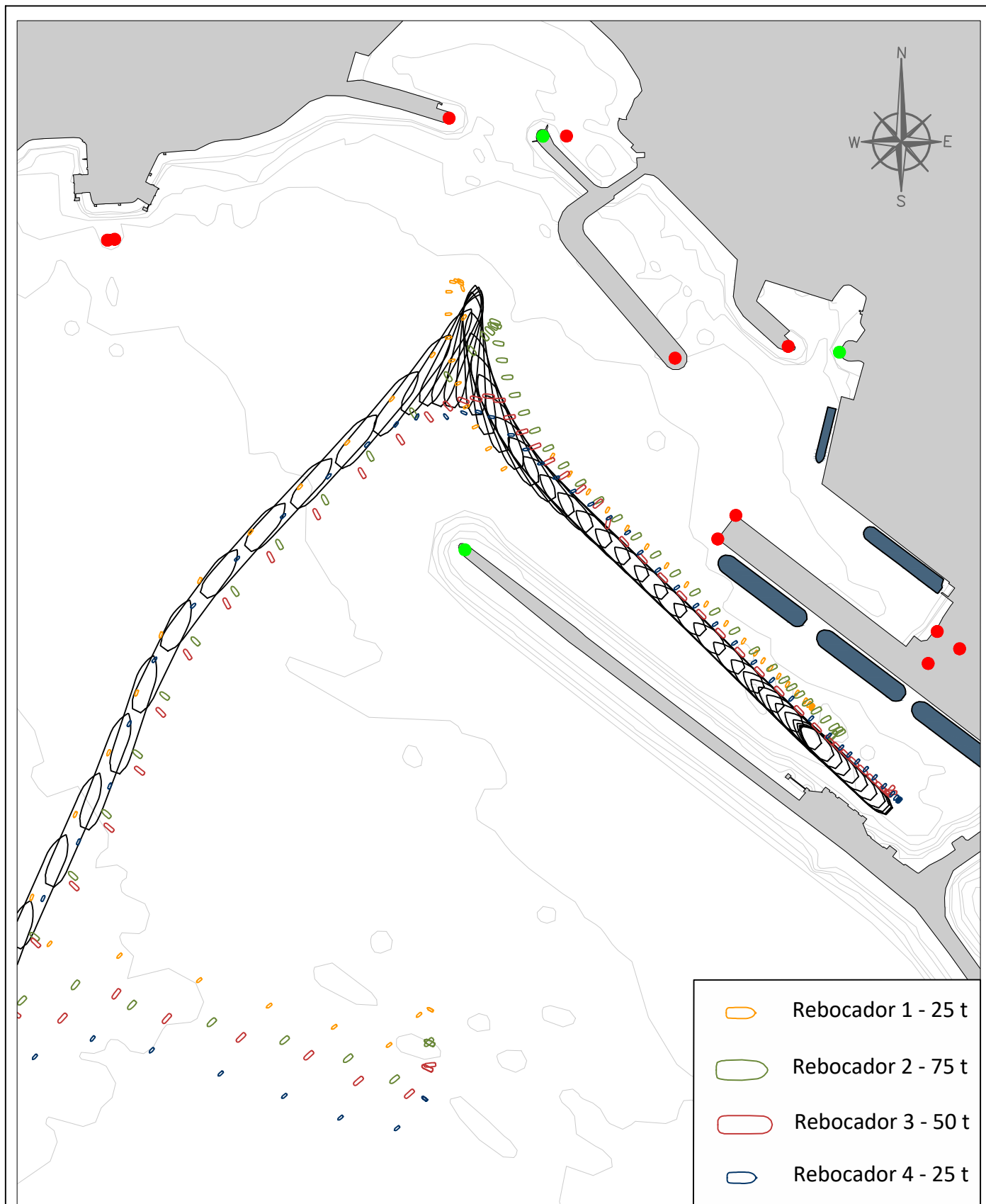


Figure: Trk-1002

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

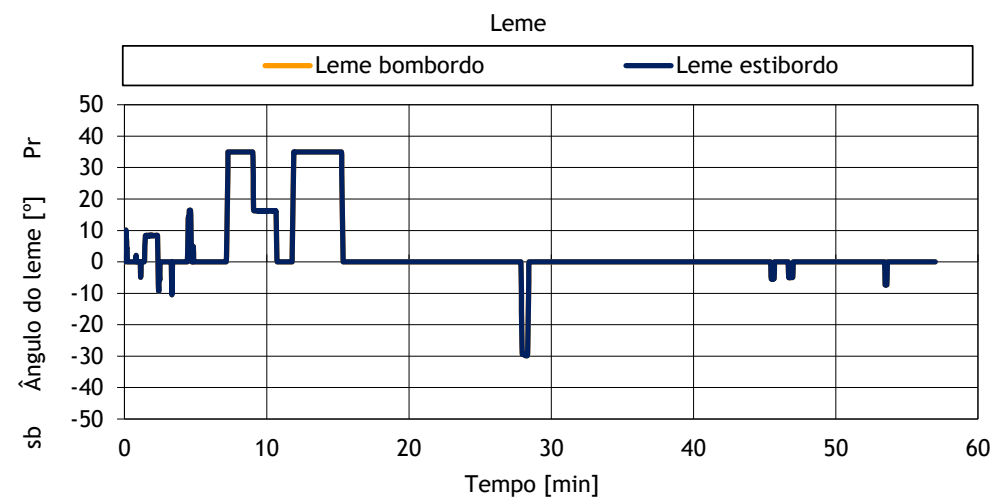
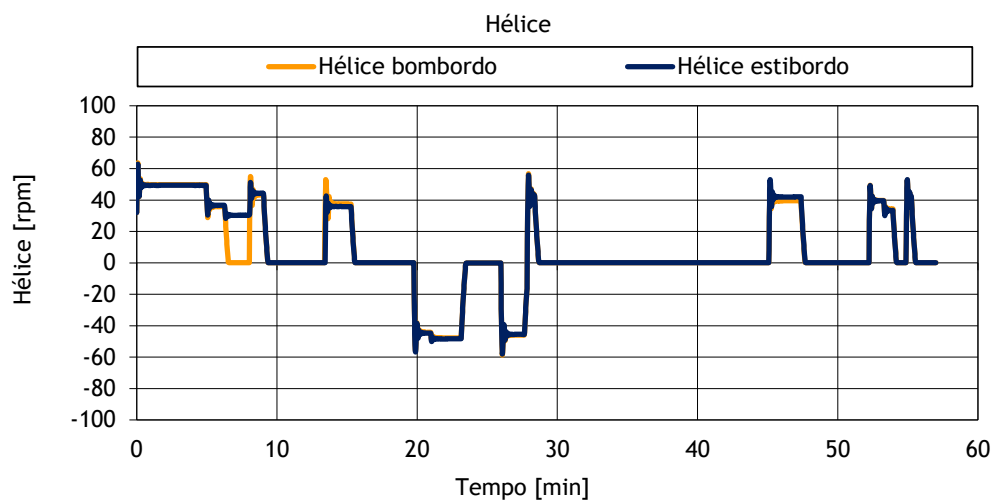
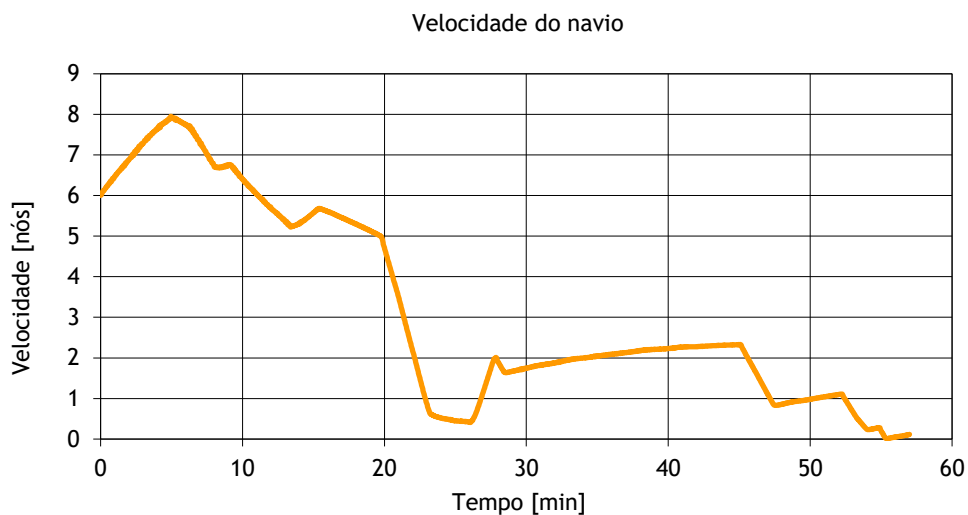
Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 3 500

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 1002

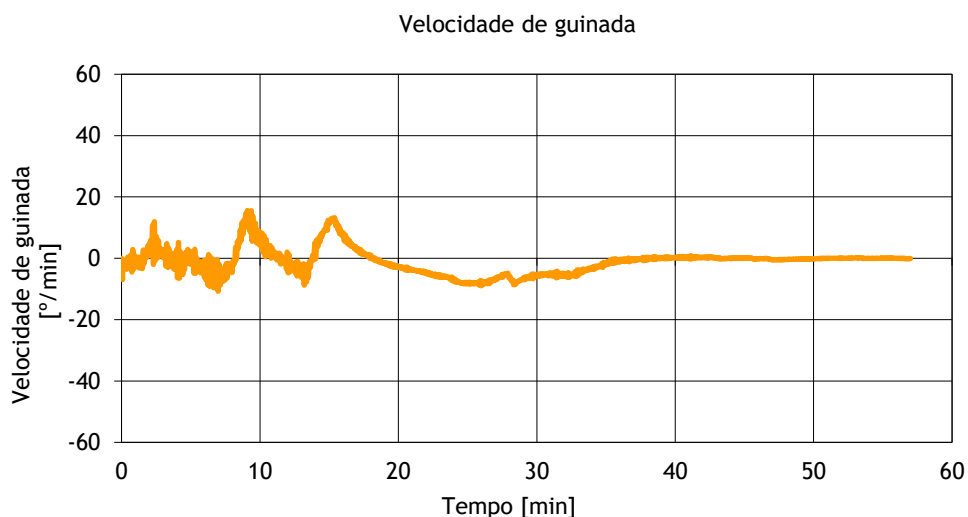
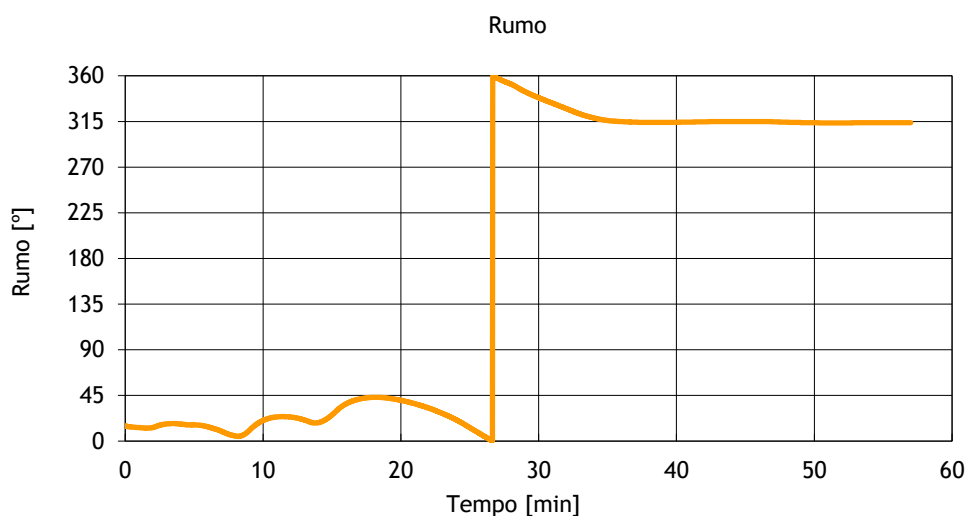
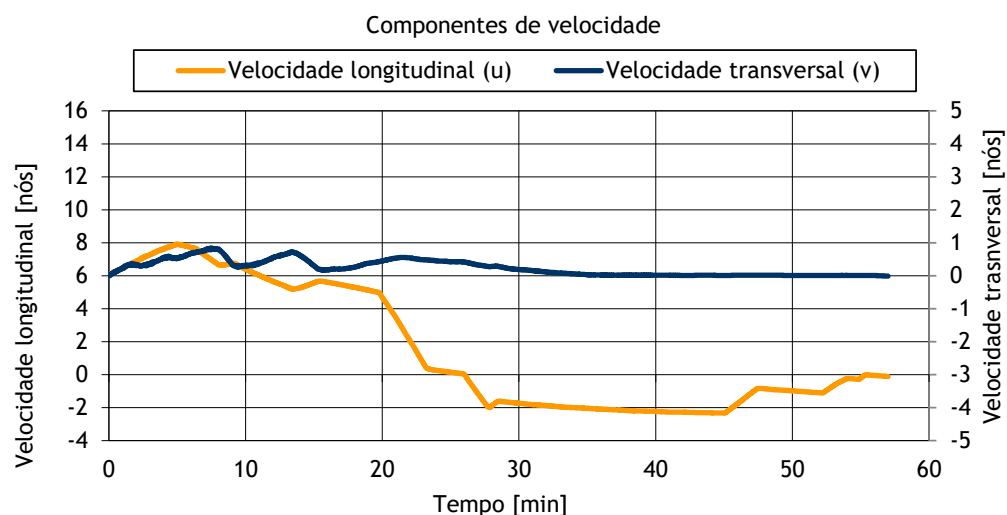
Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

Velocidade, hélice e leme



D-1002

Gráfico 1



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 1002

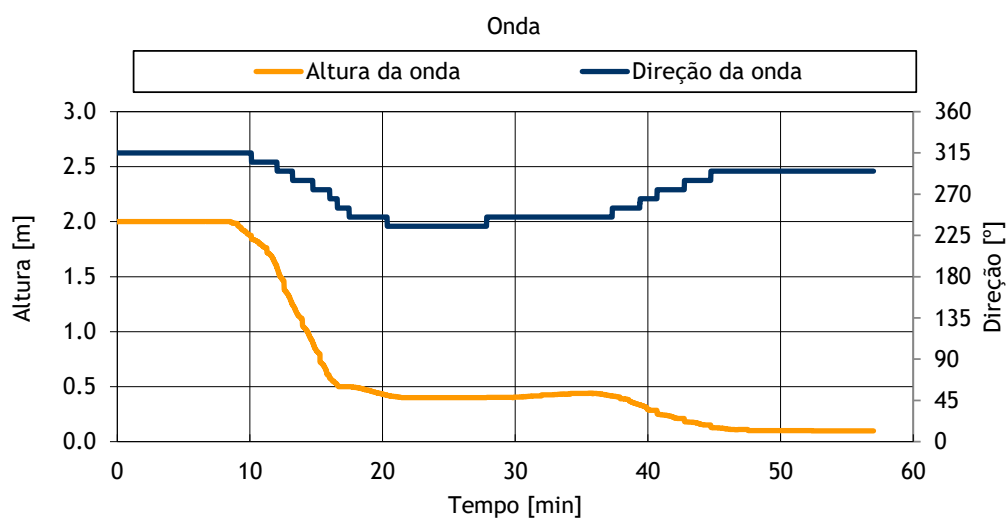
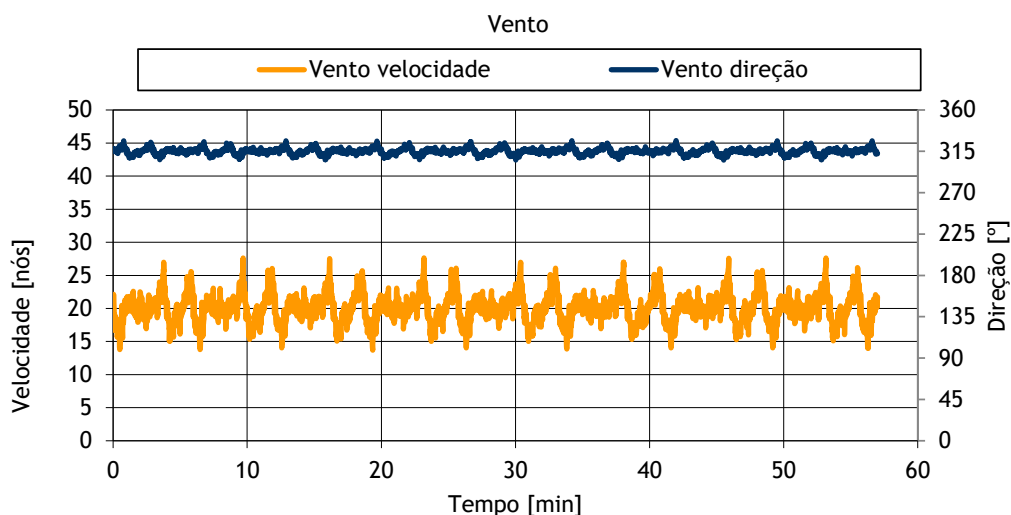
Simulador de Manobras em Tempo Real

**Componentes de velocidade e
rumo**



D-1002

Gráfico 2



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 1002

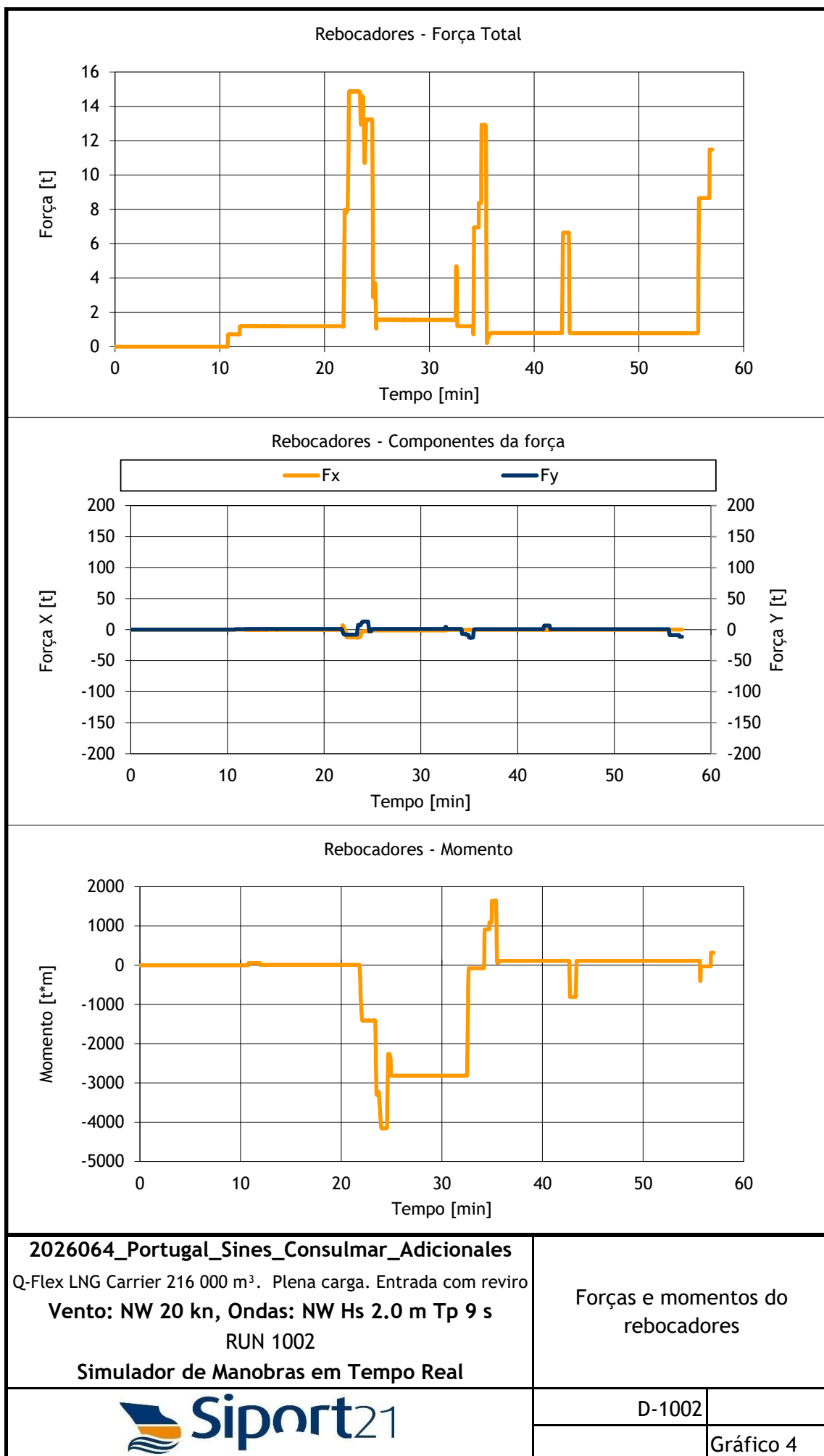
Simulador de Manobras em Tempo Real

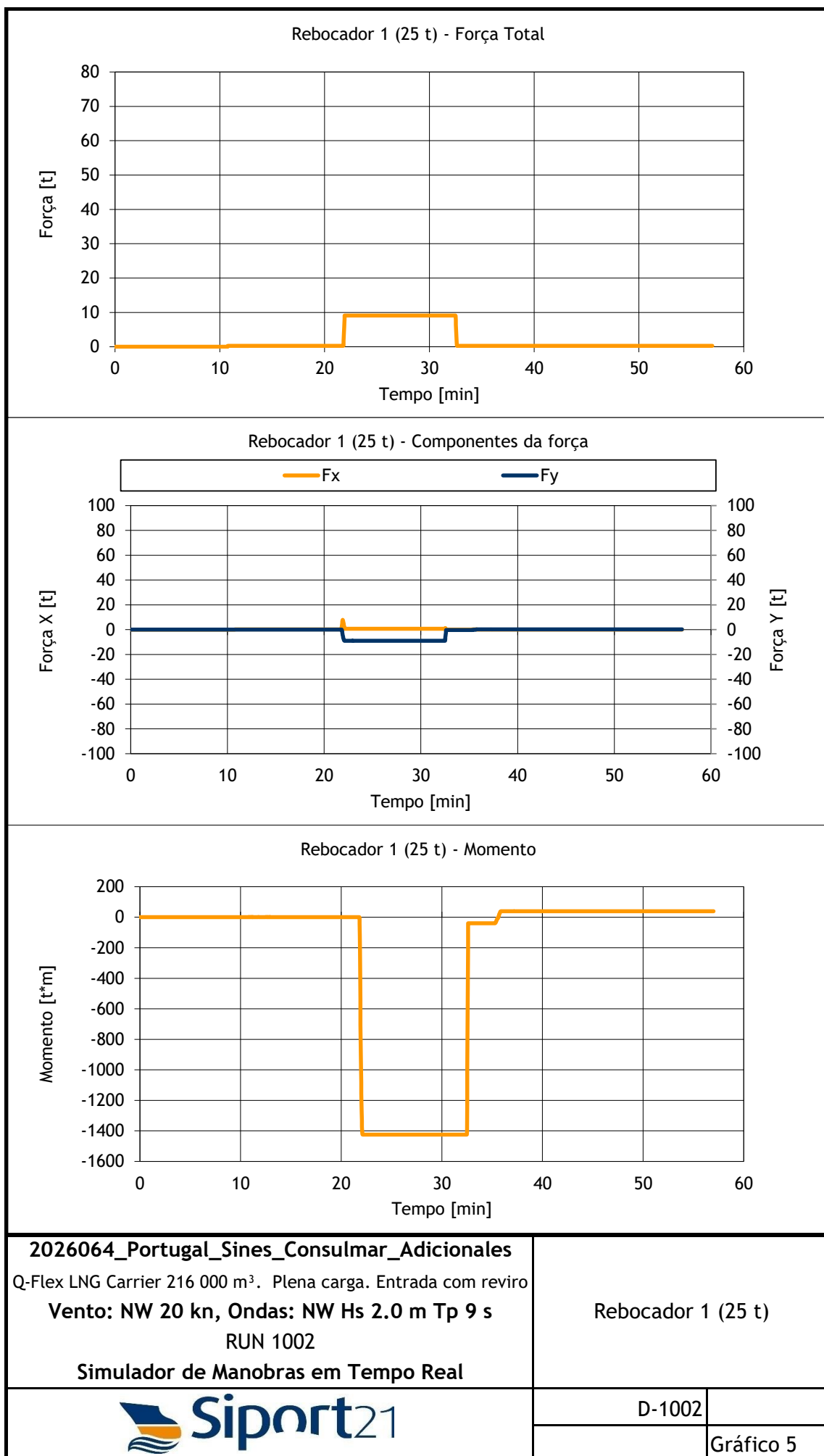
Condições climáticas

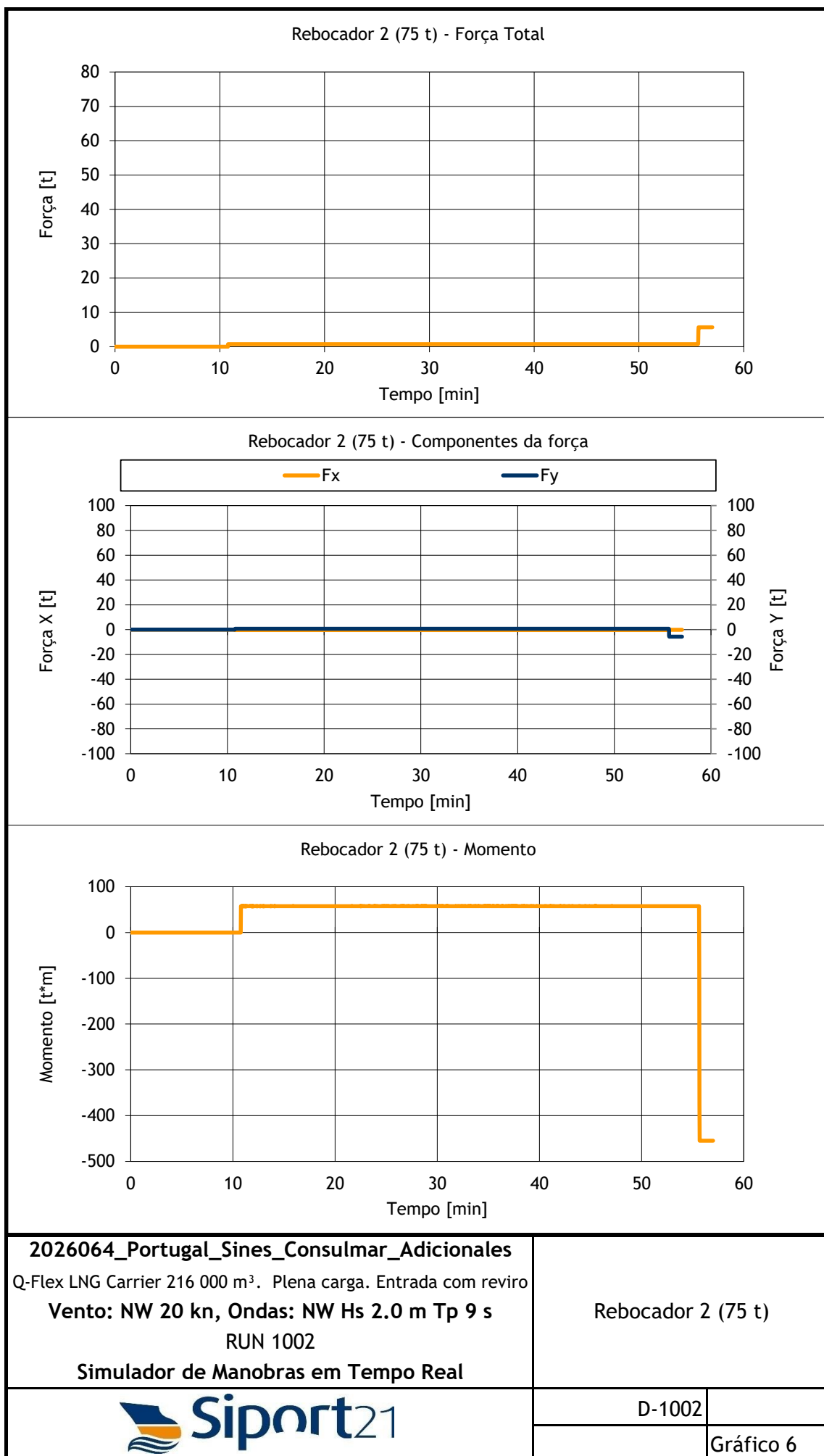


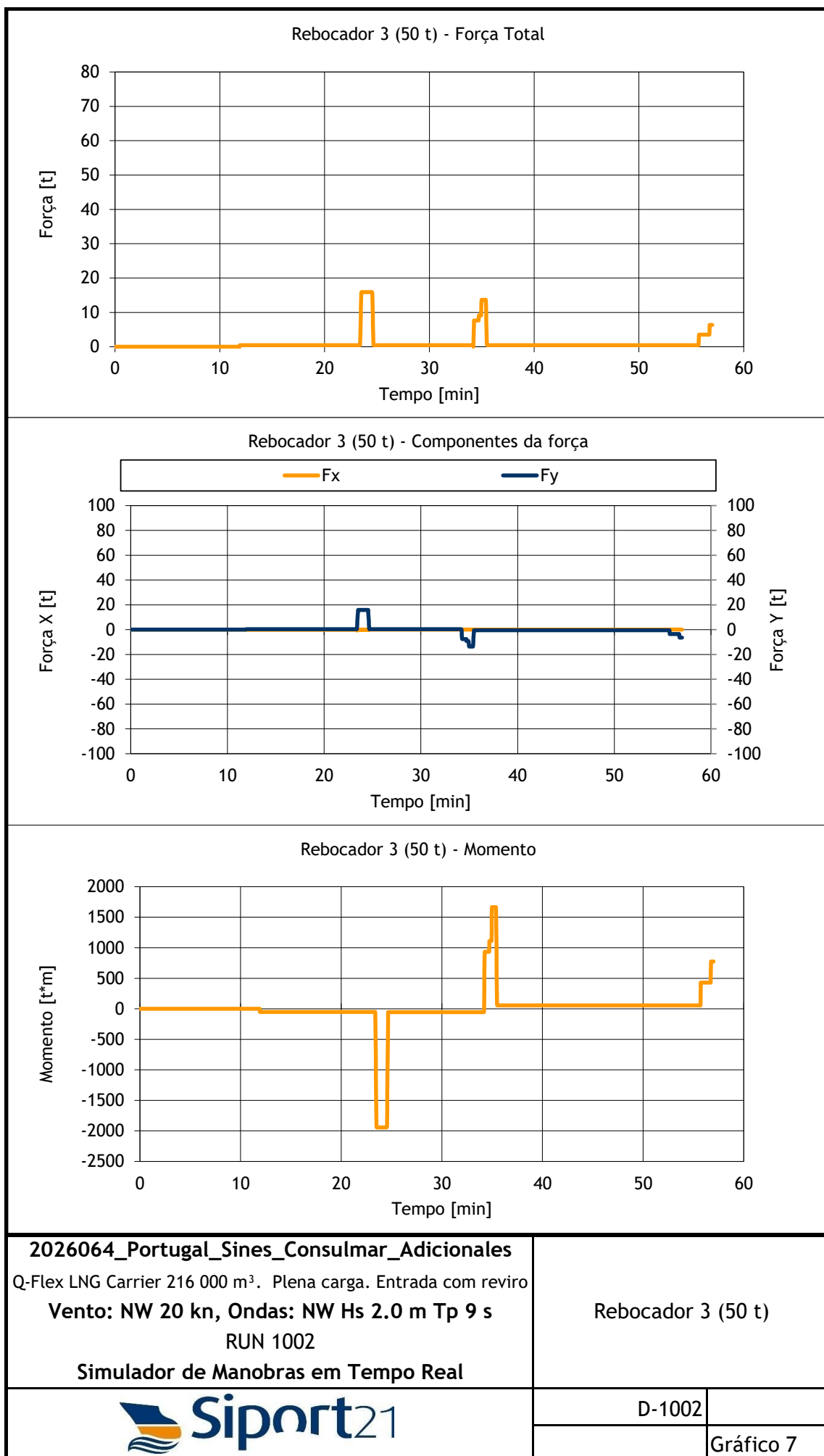
D-1002

Gráfico 3

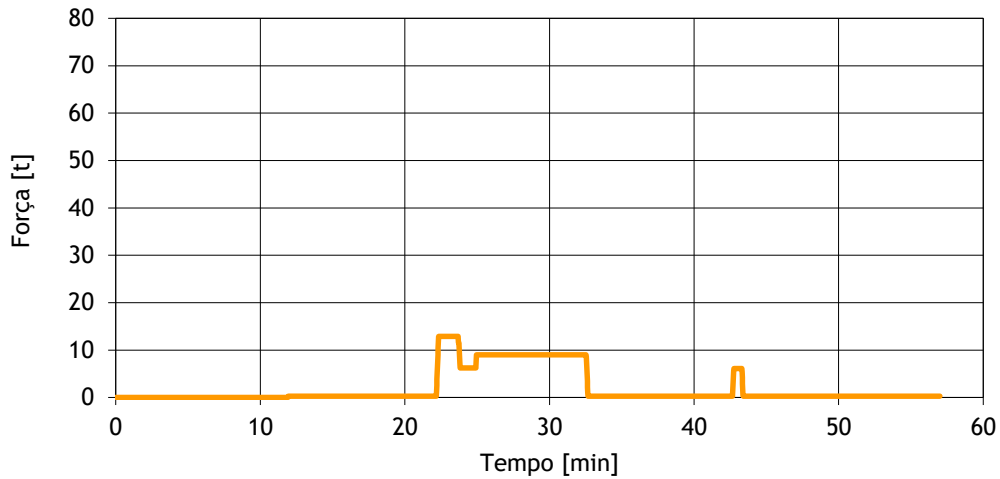




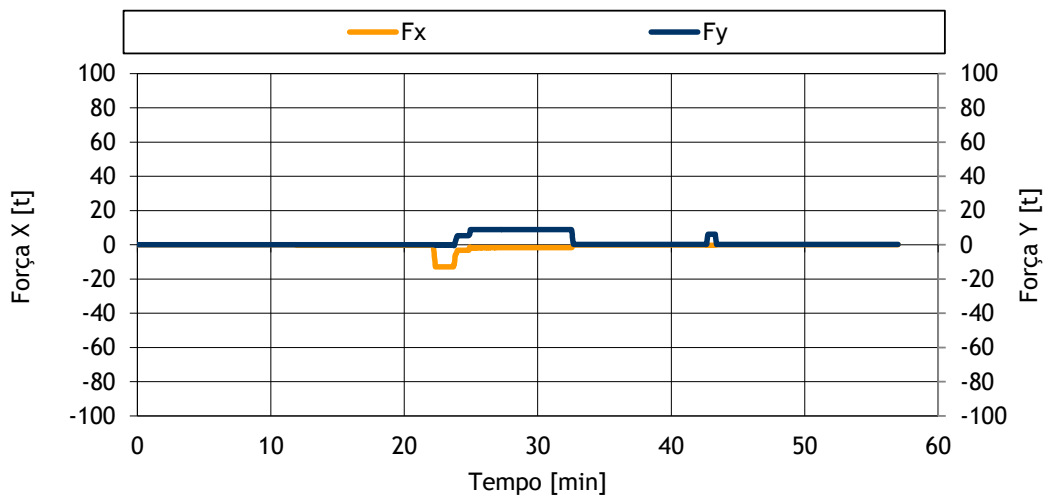




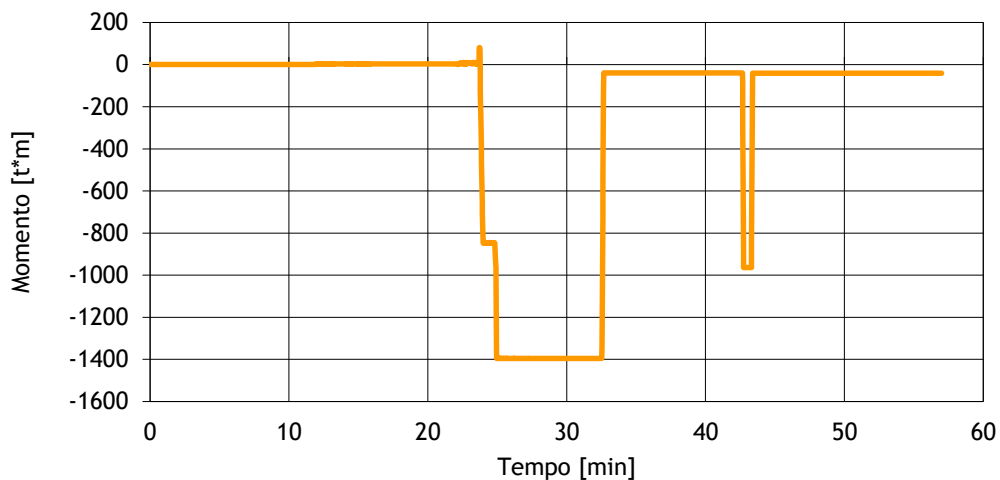
Rebocador 4 (25 t) - Força Total



Rebocador 4 (25 t) - Componentes da força



Rebocador 4 (25 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 1002

Simulador de Manobras em Tempo Real

Rebocador 4 (25 t)



D-1002

Gráfico 8

RUN 2002

**Q-Flex LNG Carrier 216 000 m³. Plena carga.
Entrada com reviro**

Vento: NW 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

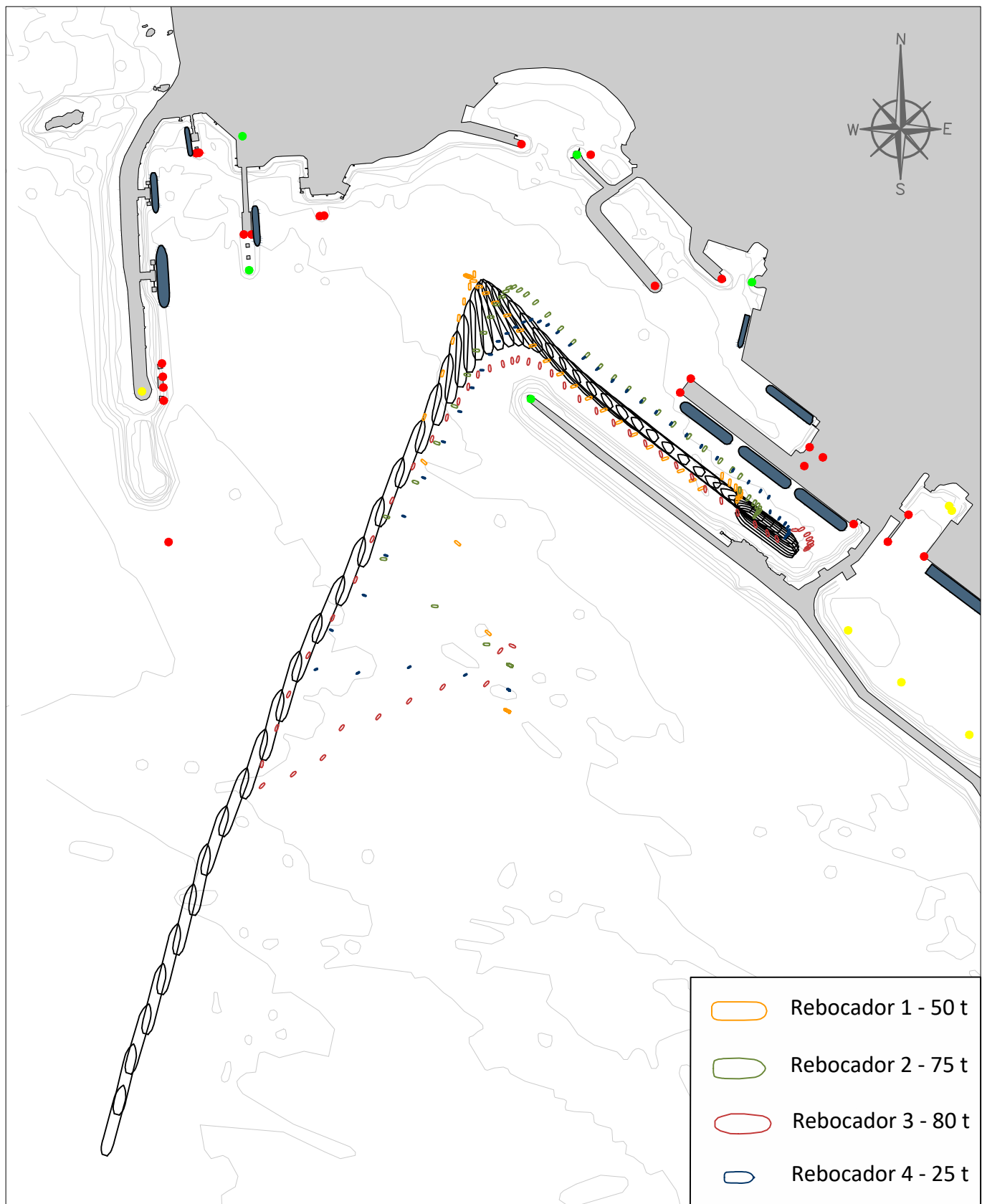


Figure: Trk-2002

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 6 000

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales

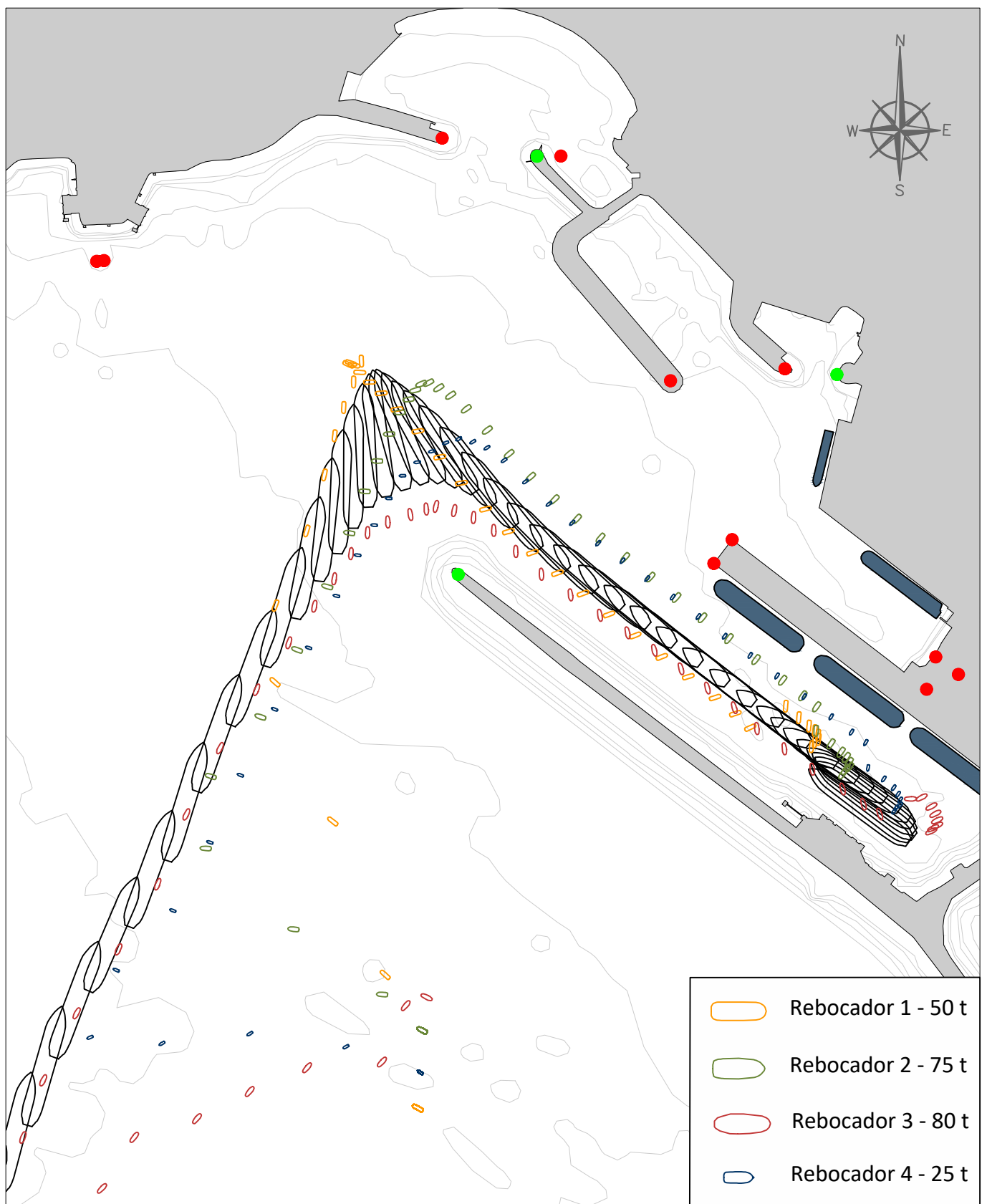


Figure: Trk-2002

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

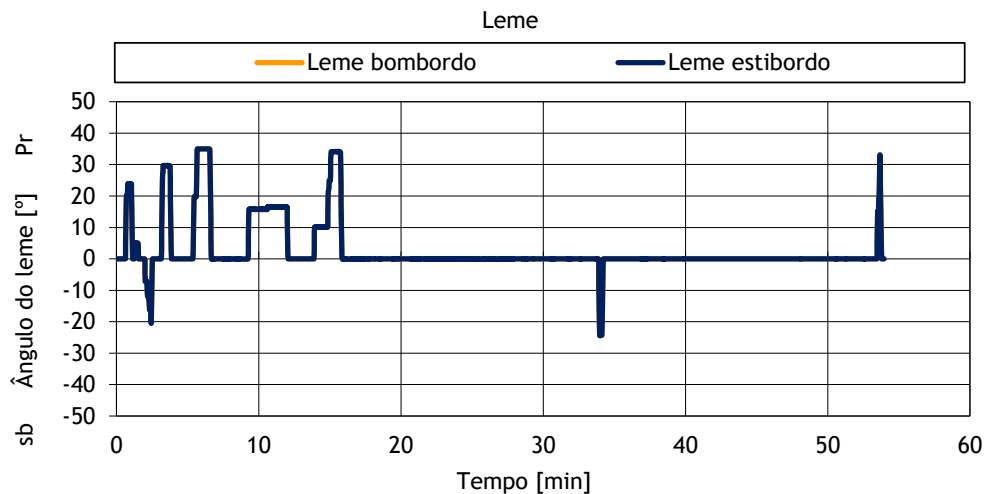
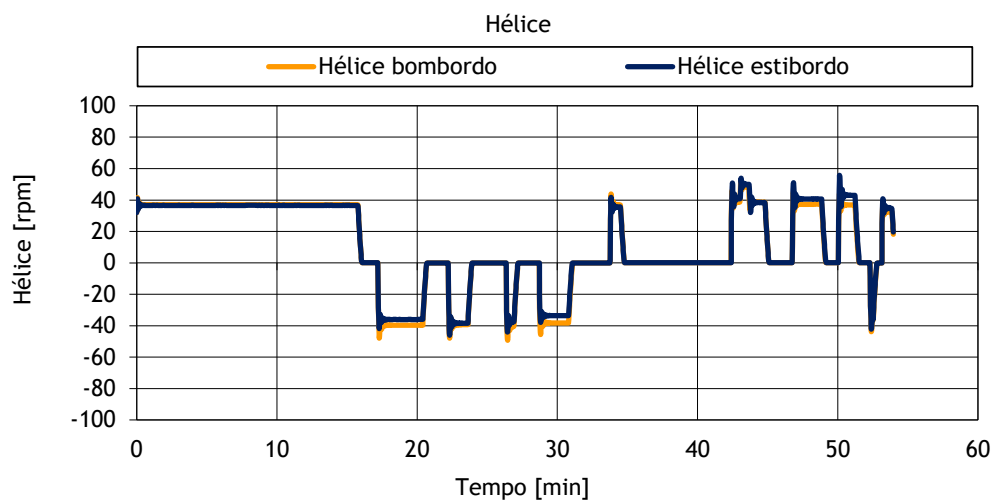
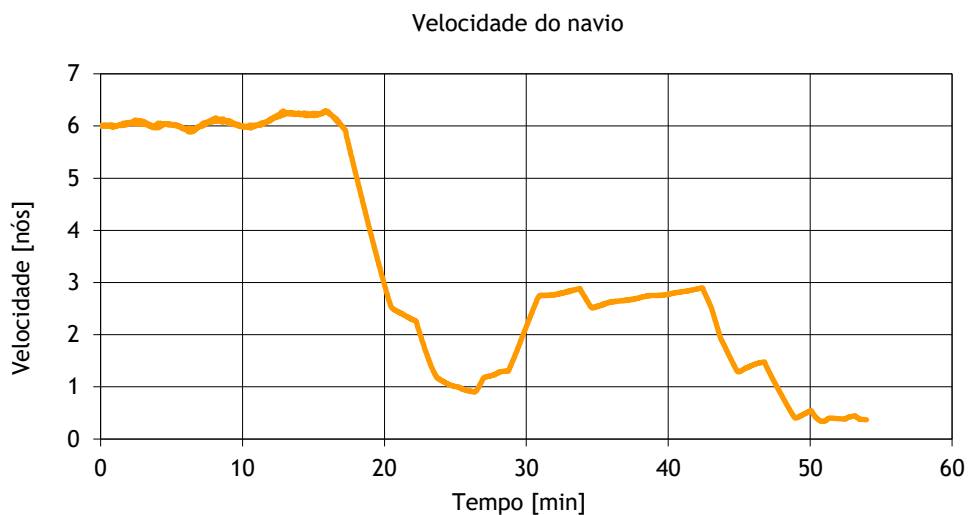
Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 3 500

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NW 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 2002

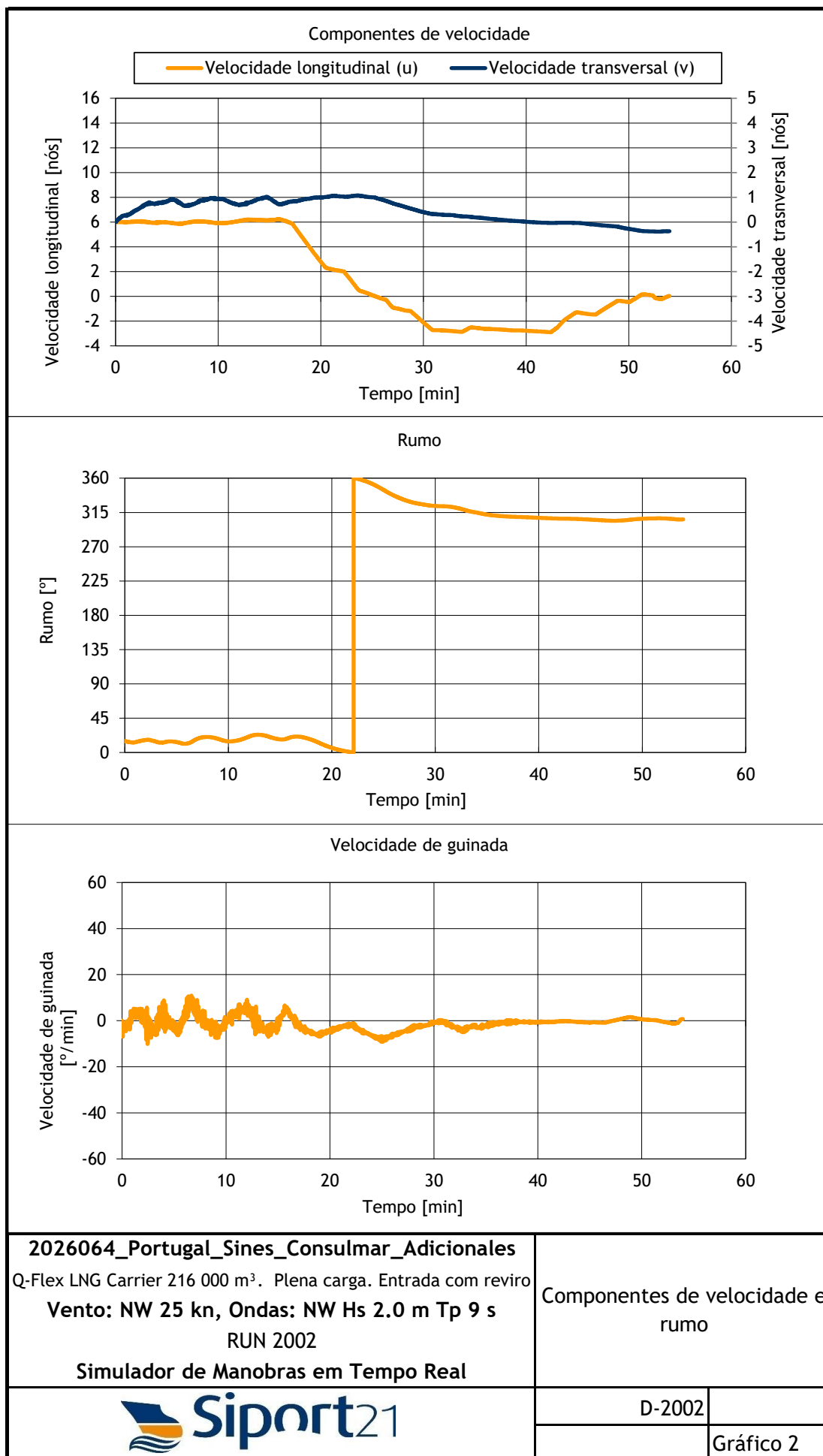
Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

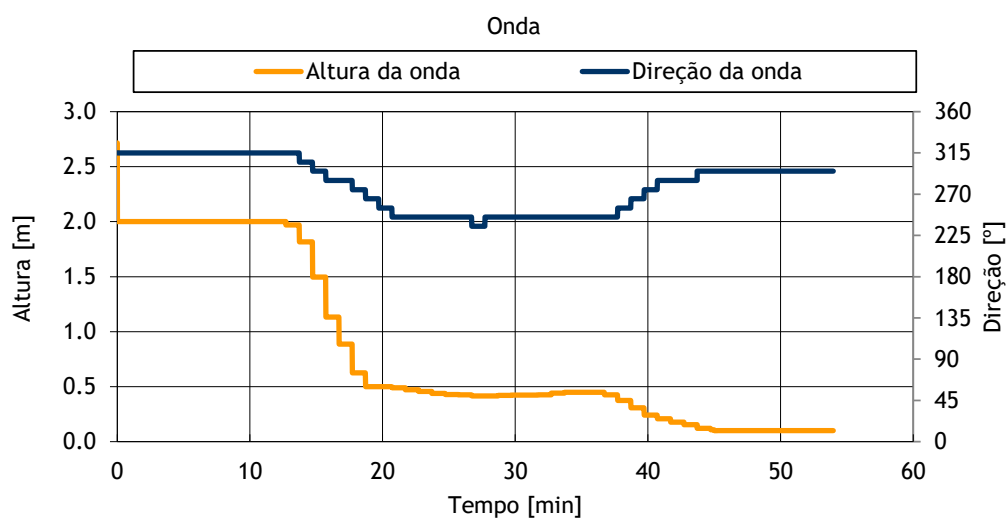
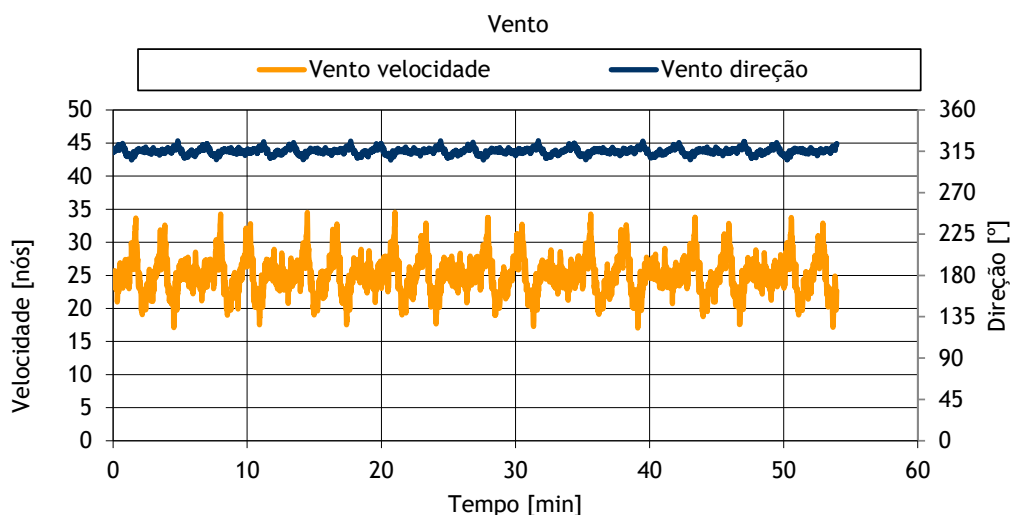
Velocidade, hélice e leme



D-2002

Gráfico 1





2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NW 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 2002

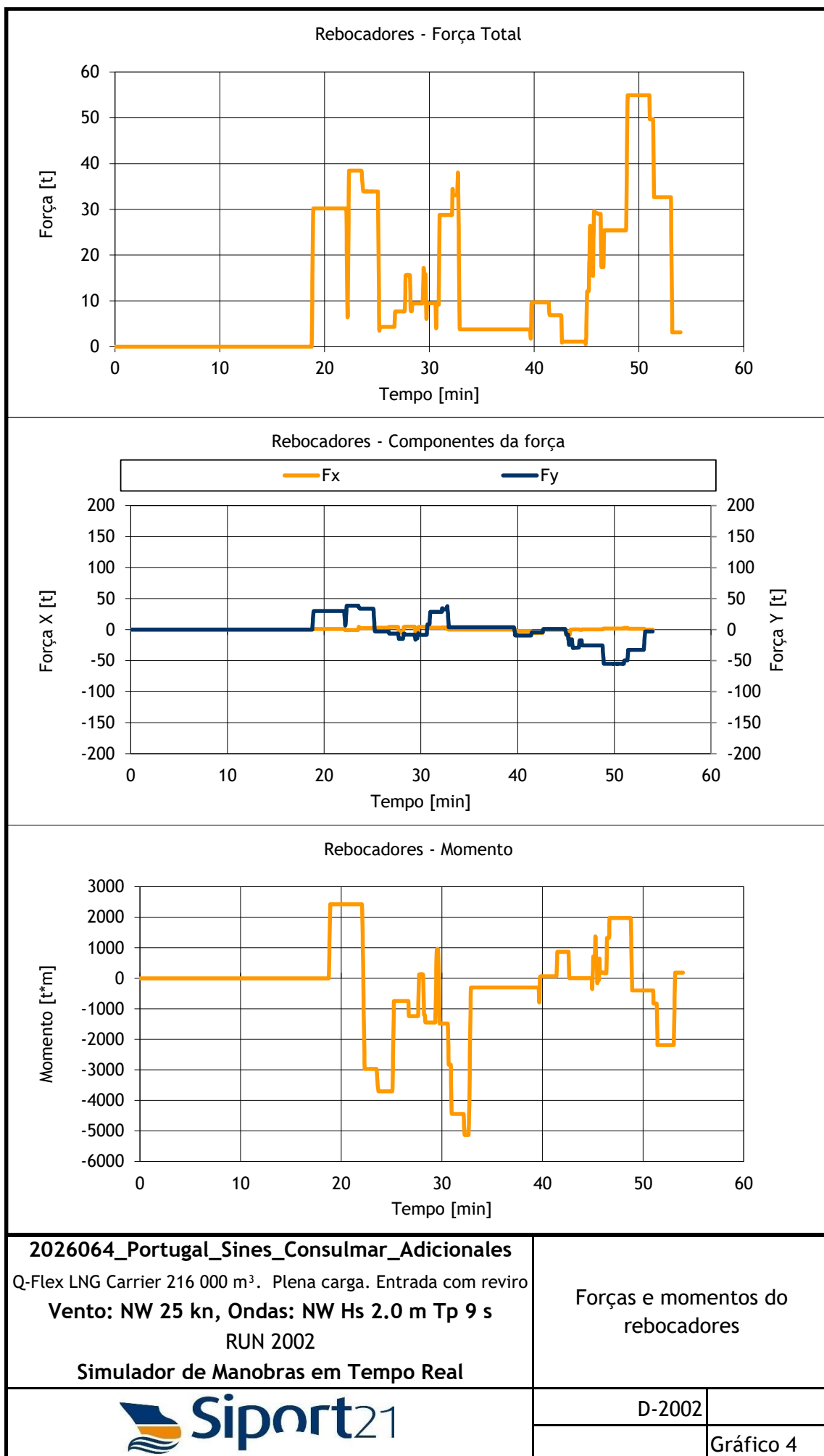
Simulador de Manobras em Tempo Real

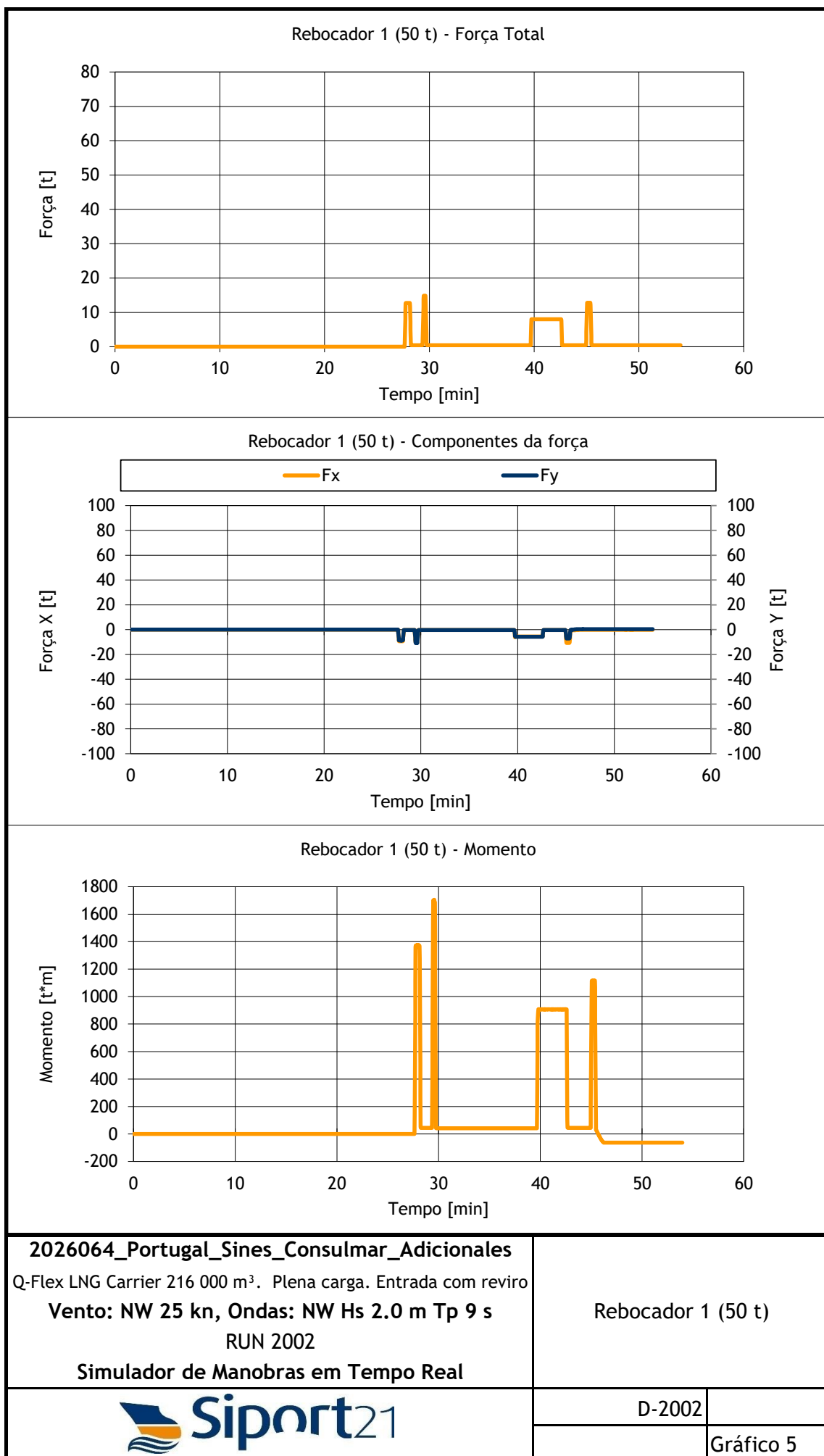
Condições climáticas



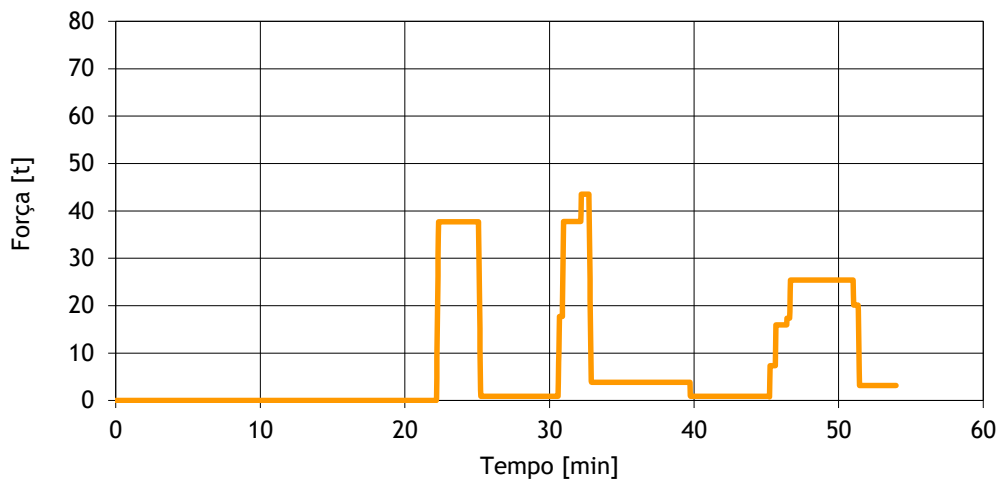
D-2002

Gráfico 3

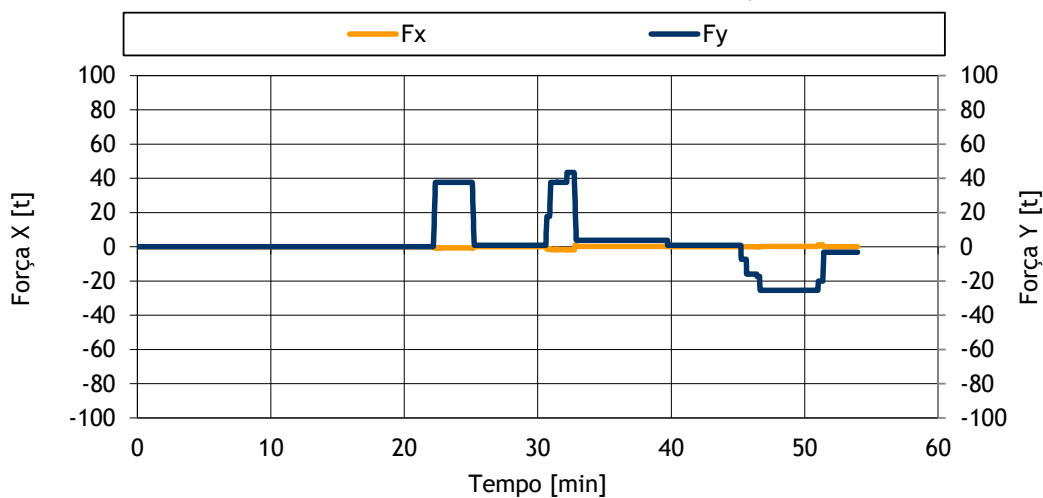




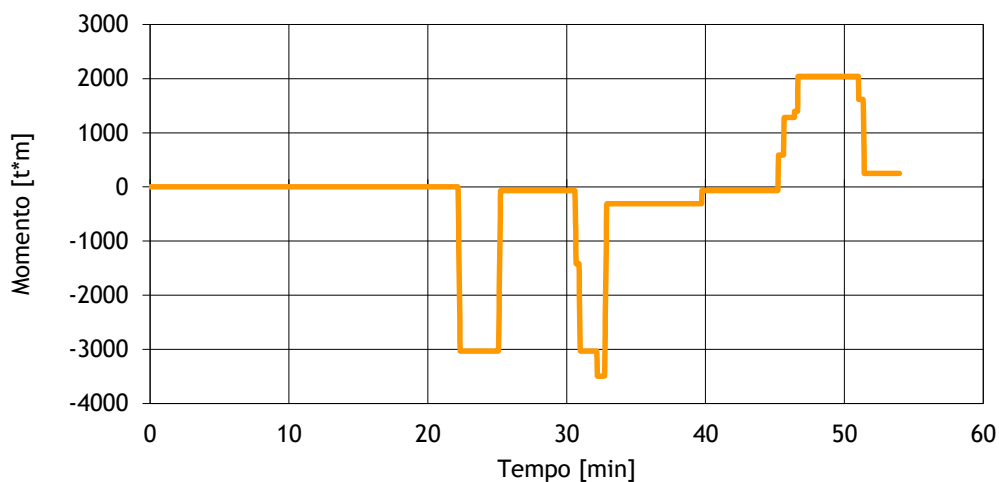
Rebocador 2 (75 t) - Força Total



Rebocador 2 (75 t) - Componentes da força



Rebocador 2 (75 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NW 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 2002

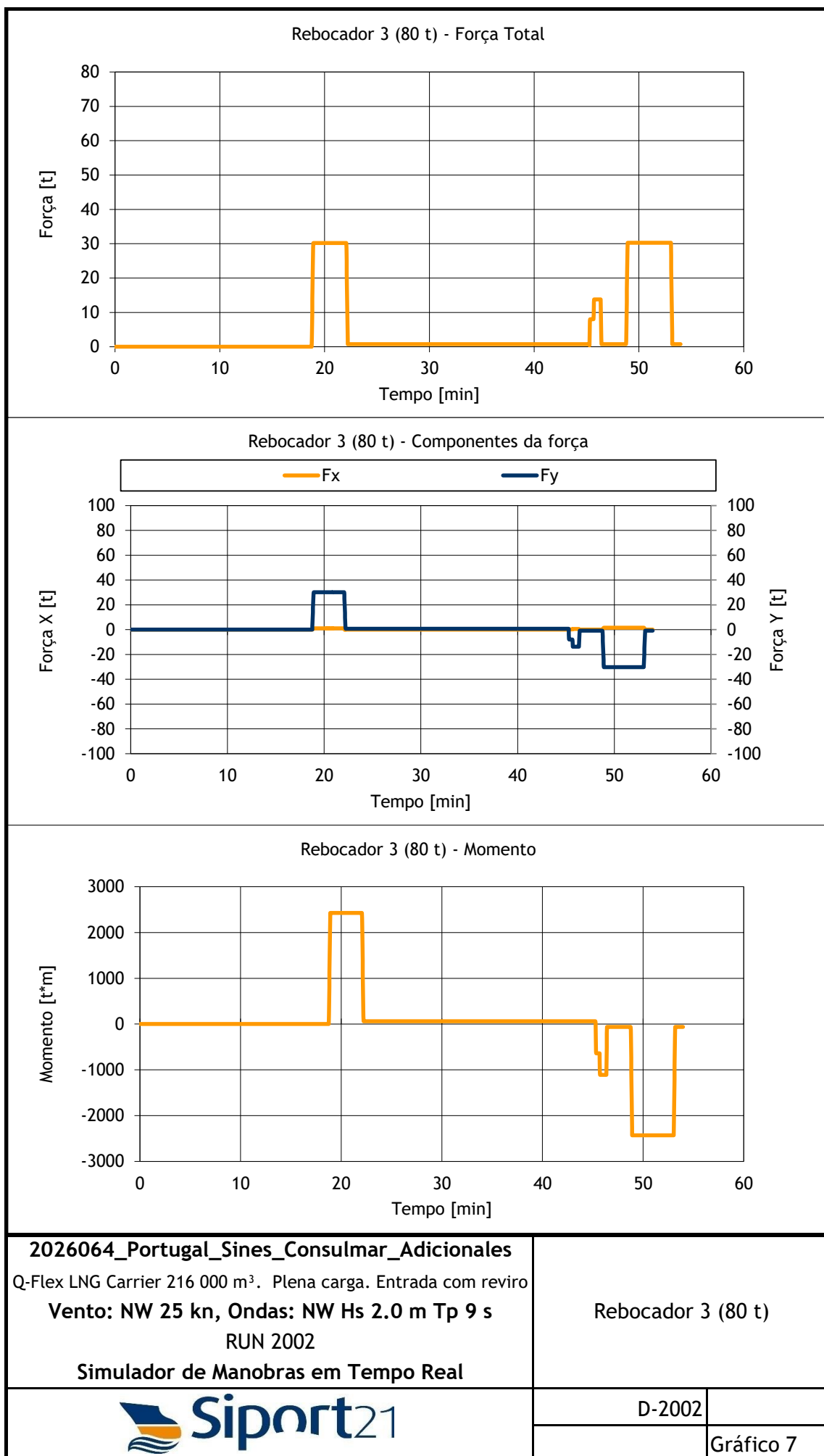
Simulador de Manobras em Tempo Real

Rebocador 2 (75 t)

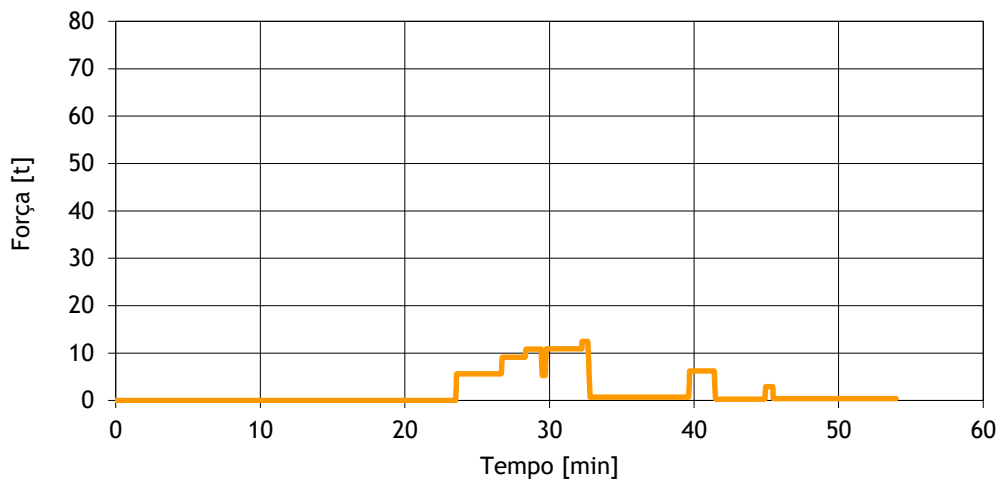


D-2002

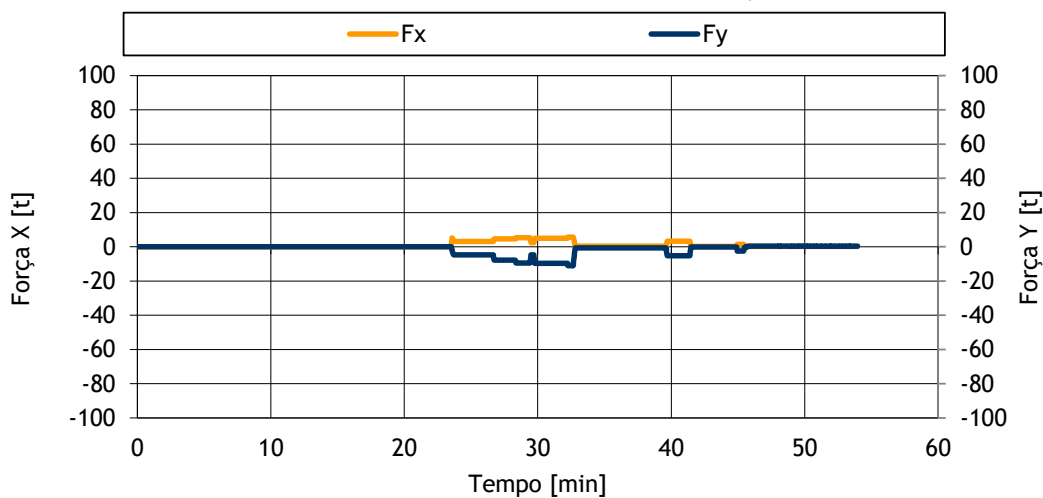
Gráfico 6



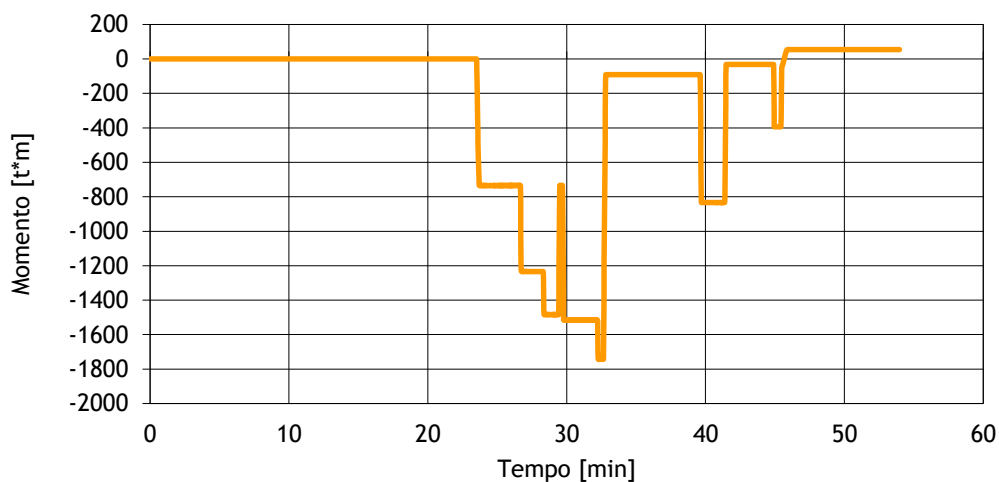
Rebocador 4 (25 t) - Força Total



Rebocador 4 (25 t) - Componentes da força



Rebocador 4 (25 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NW 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 2002

Simulador de Manobras em Tempo Real

Rebocador 4 (25 t)



D-2002

Gráfico 8

RUN 3002

**Q-Flex LNG Carrier 216 000 m³. Plena carga.
Entrada com reviro**

Vento: SW 20 kn, Ondas: SW Hs 2.0 m Tp 10 s

Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

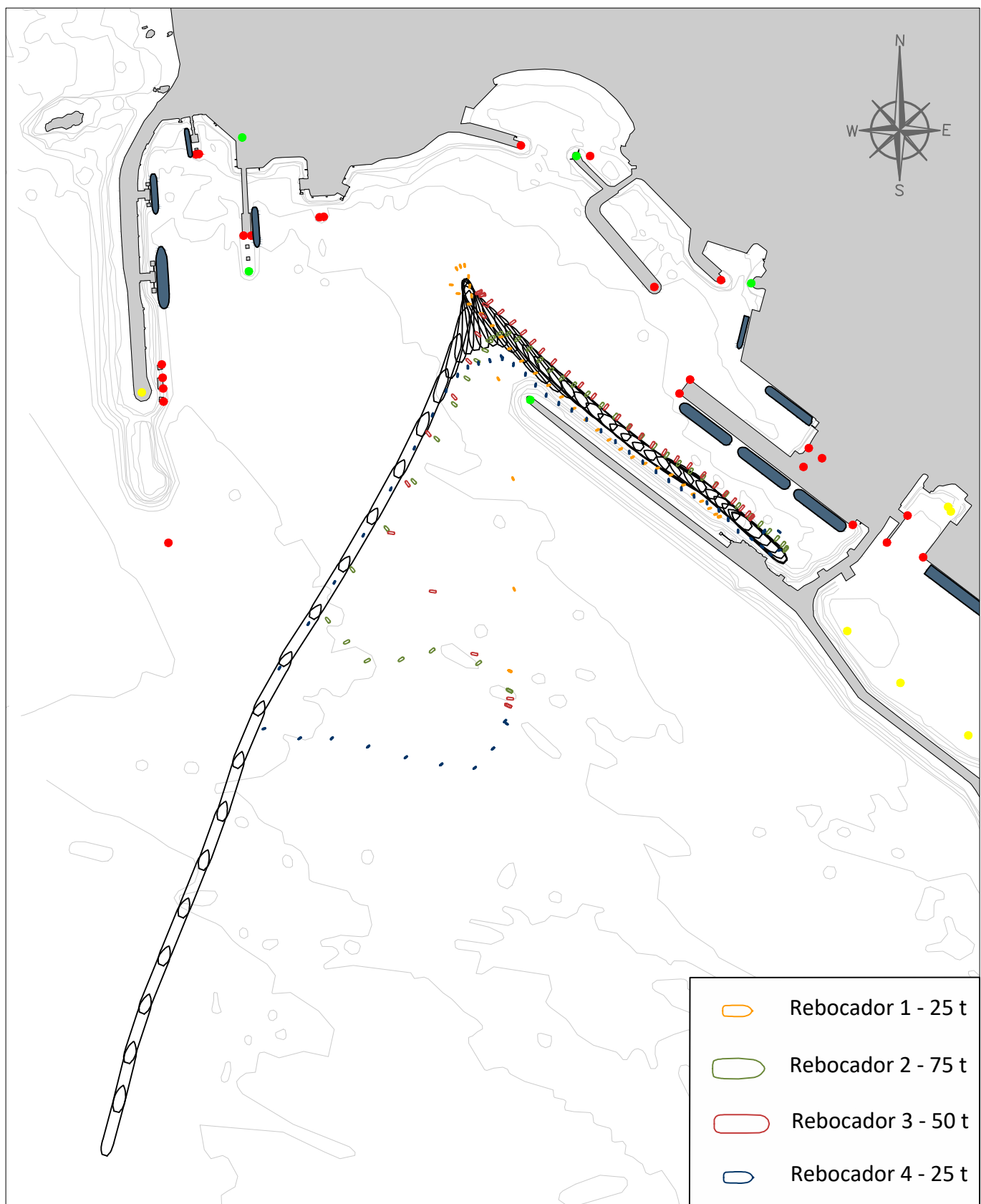


Figure: Trk-3002

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: SW 20 kn, Ondas: SW Hs 2.0 m Tp 10 s

Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 6 000

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales

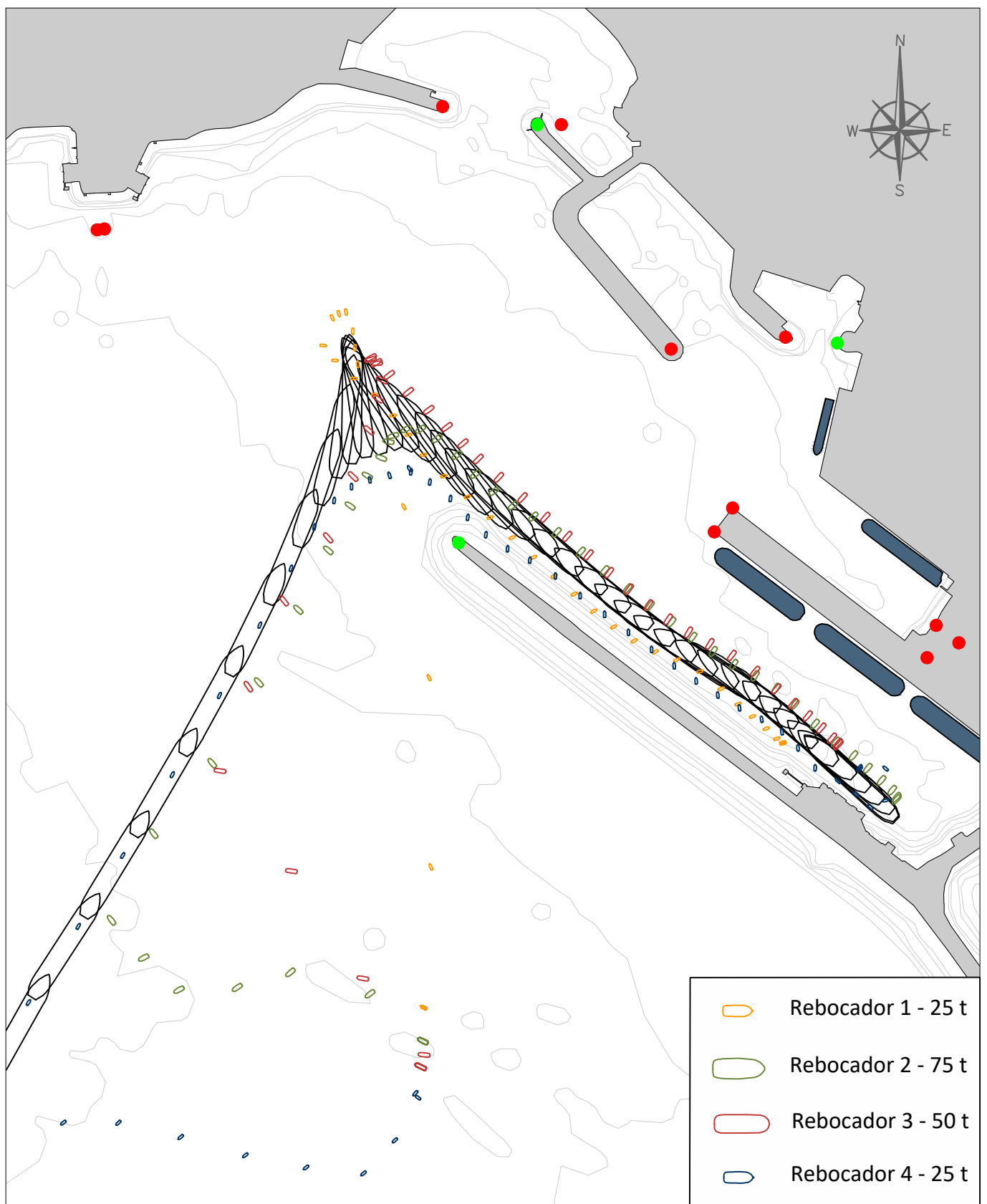


Figure: Trk-3002

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: SW 20 kn, Ondas: SW Hs 2.0 m Tp 10 s

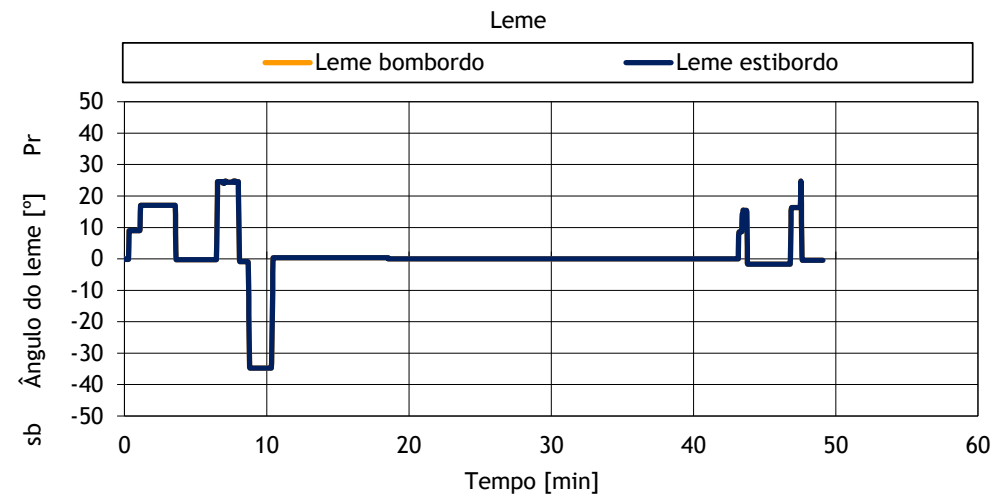
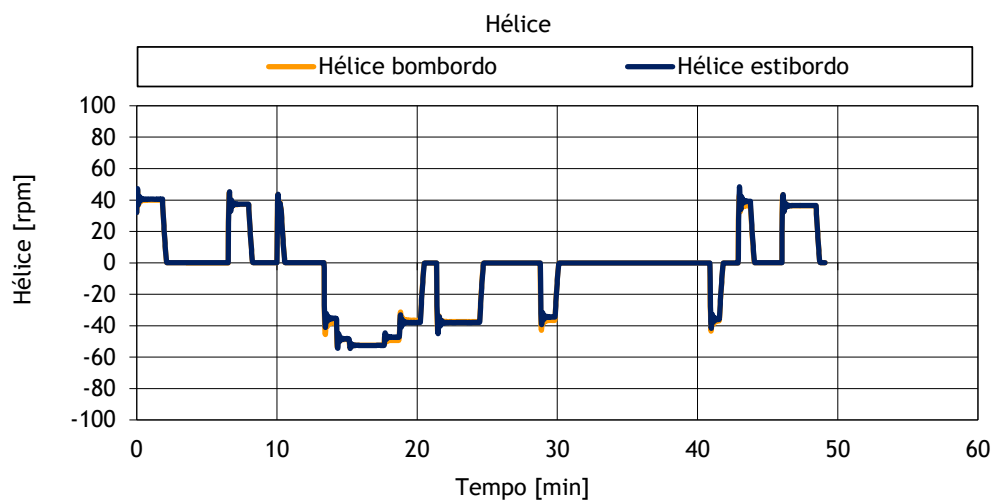
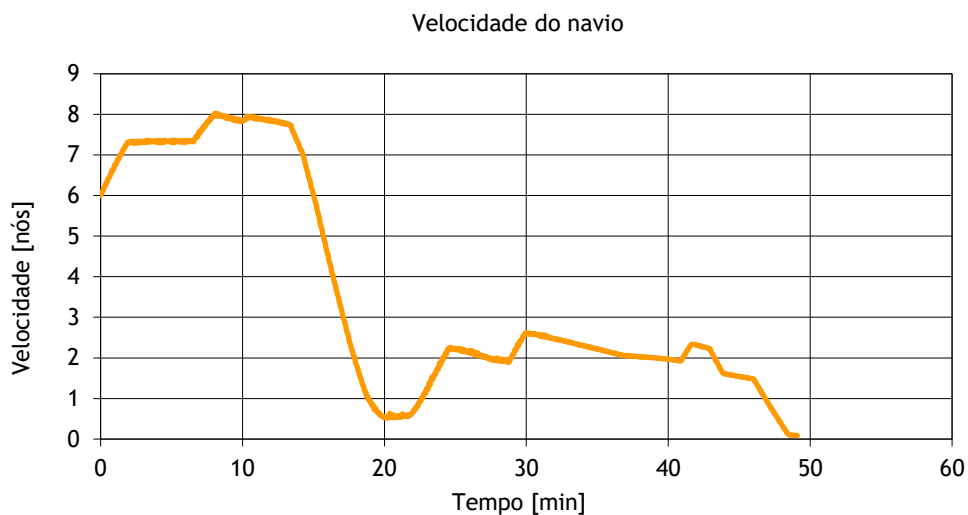
Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 3 500

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: SW 20 kn, Ondas: SW Hs 2.0 m Tp 10 s

RUN 3002

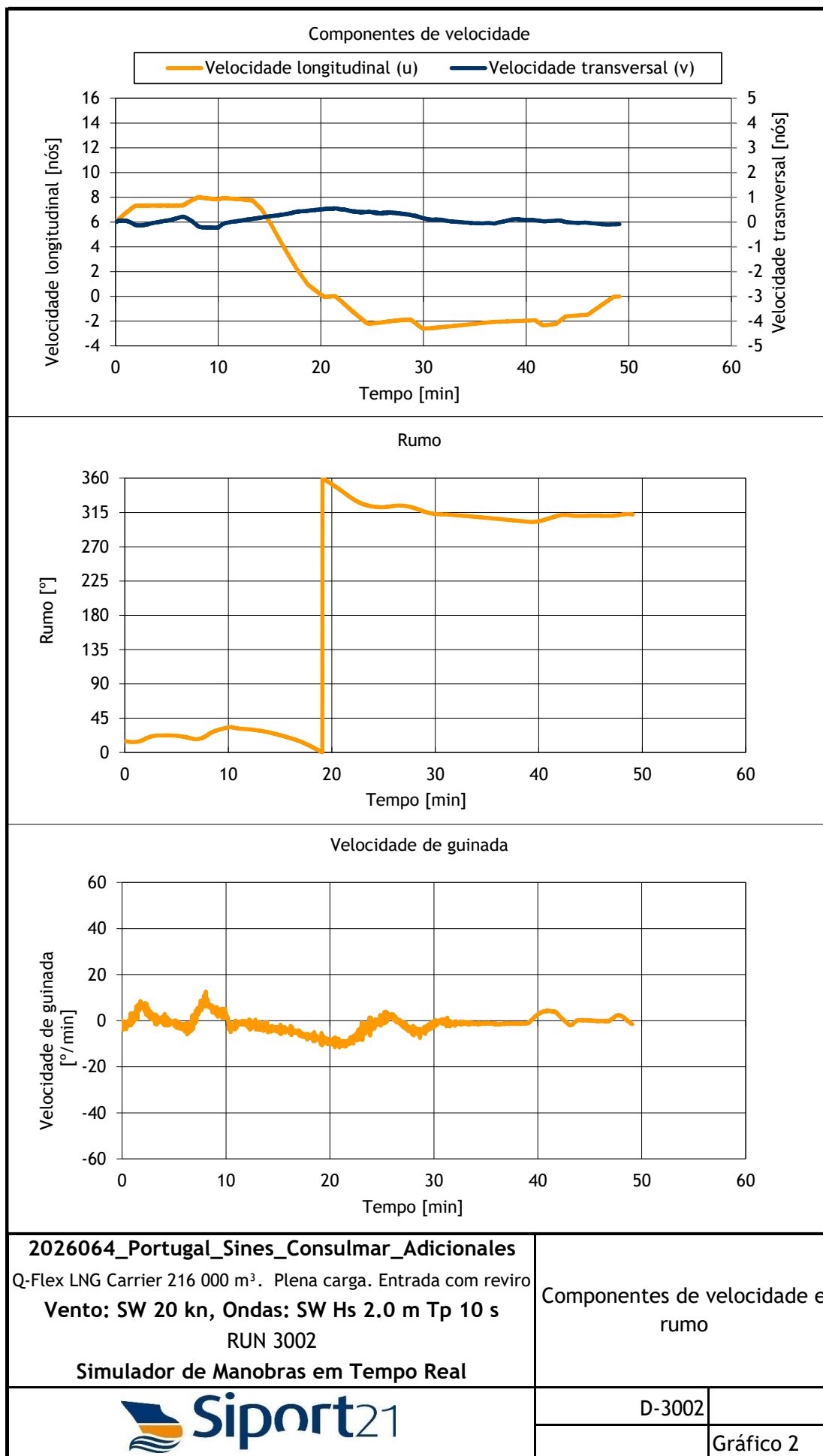
Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

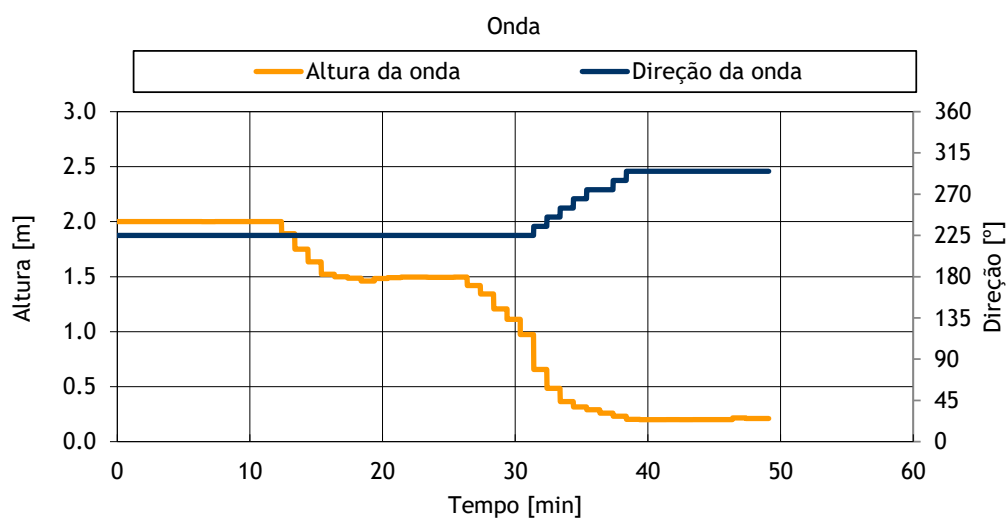
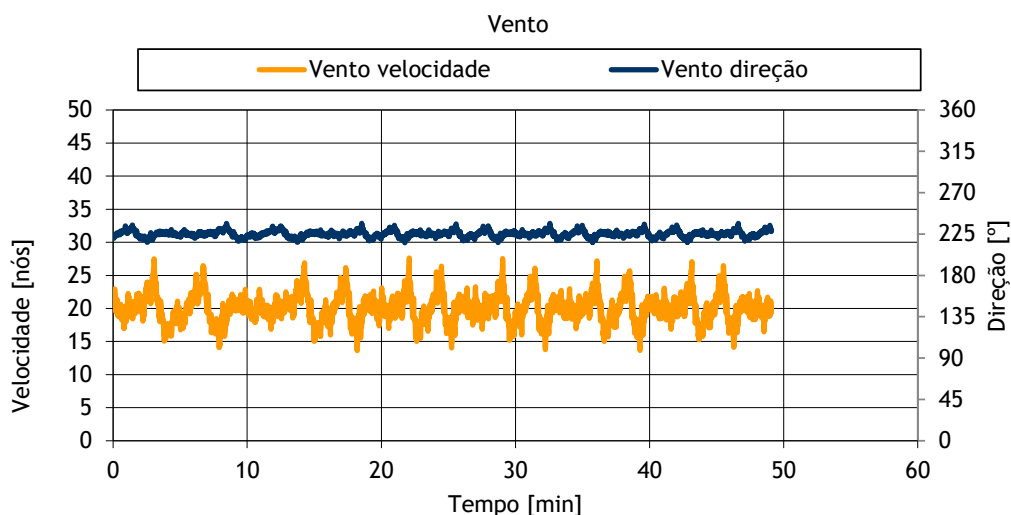
Velocidade, hélice e leme



D-3002

Gráfico 1





2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: SW 20 kn, Ondas: SW Hs 2.0 m Tp 10 s

RUN 3002

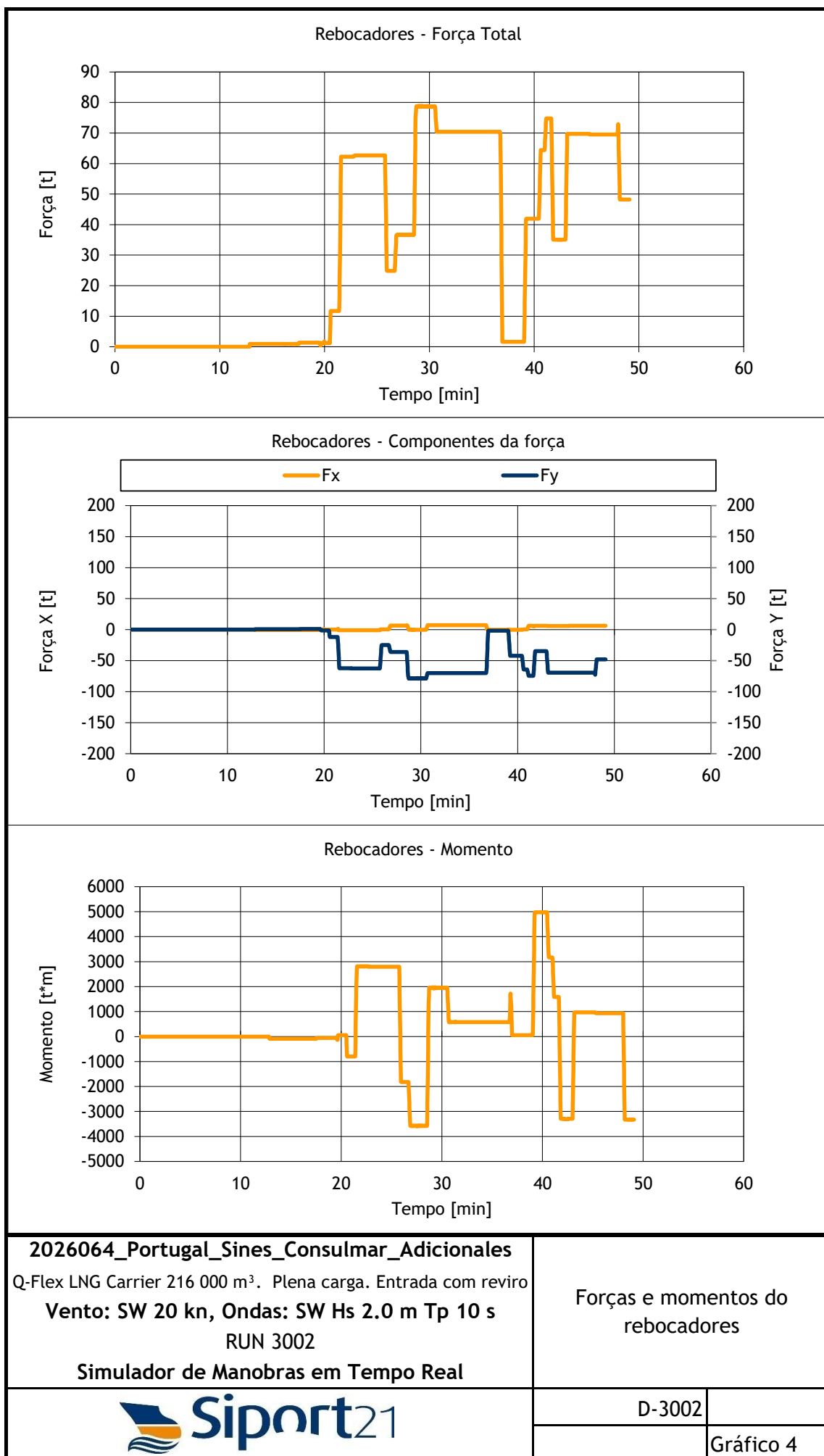
Simulador de Manobras em Tempo Real

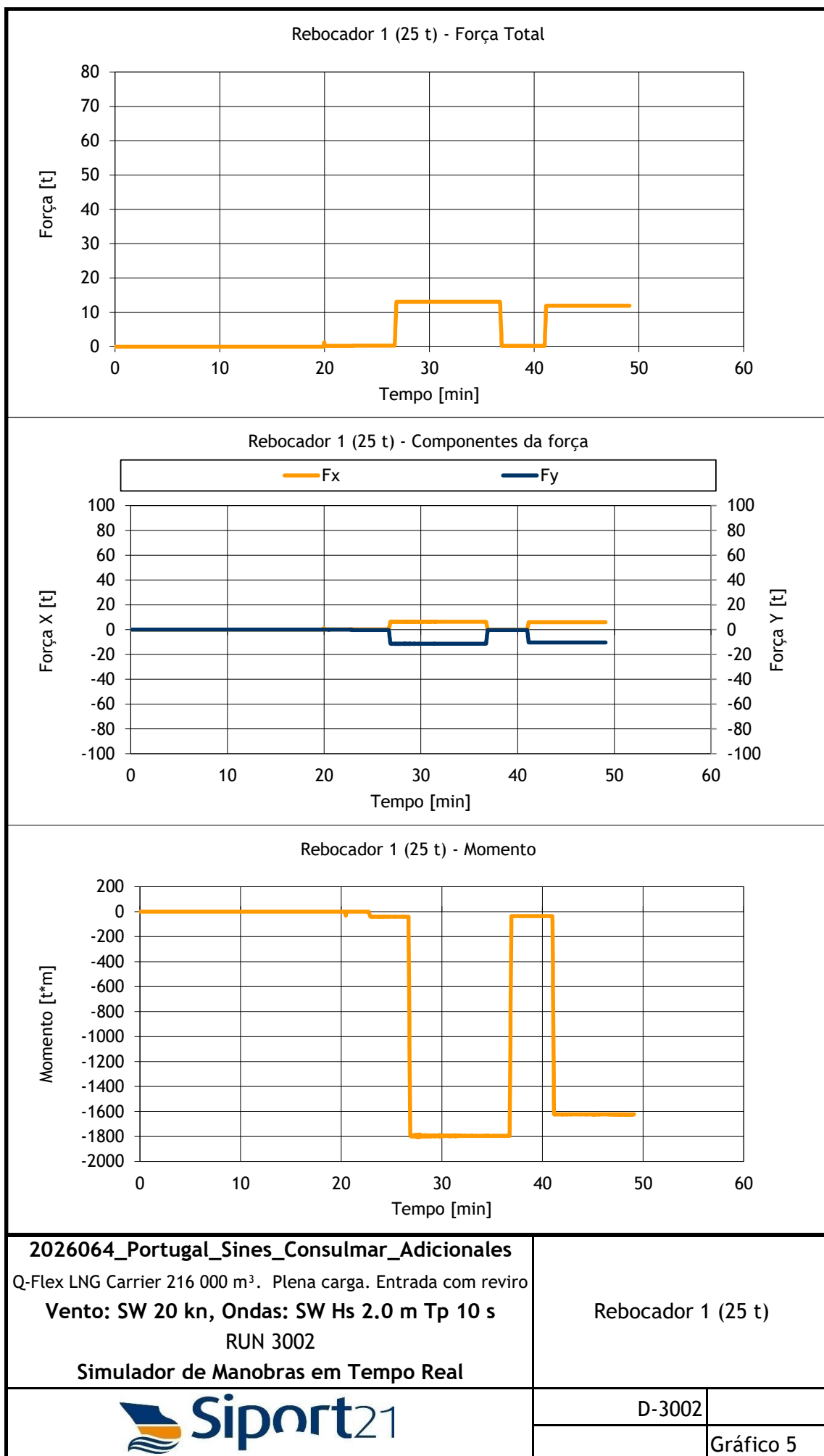
Condições climáticas

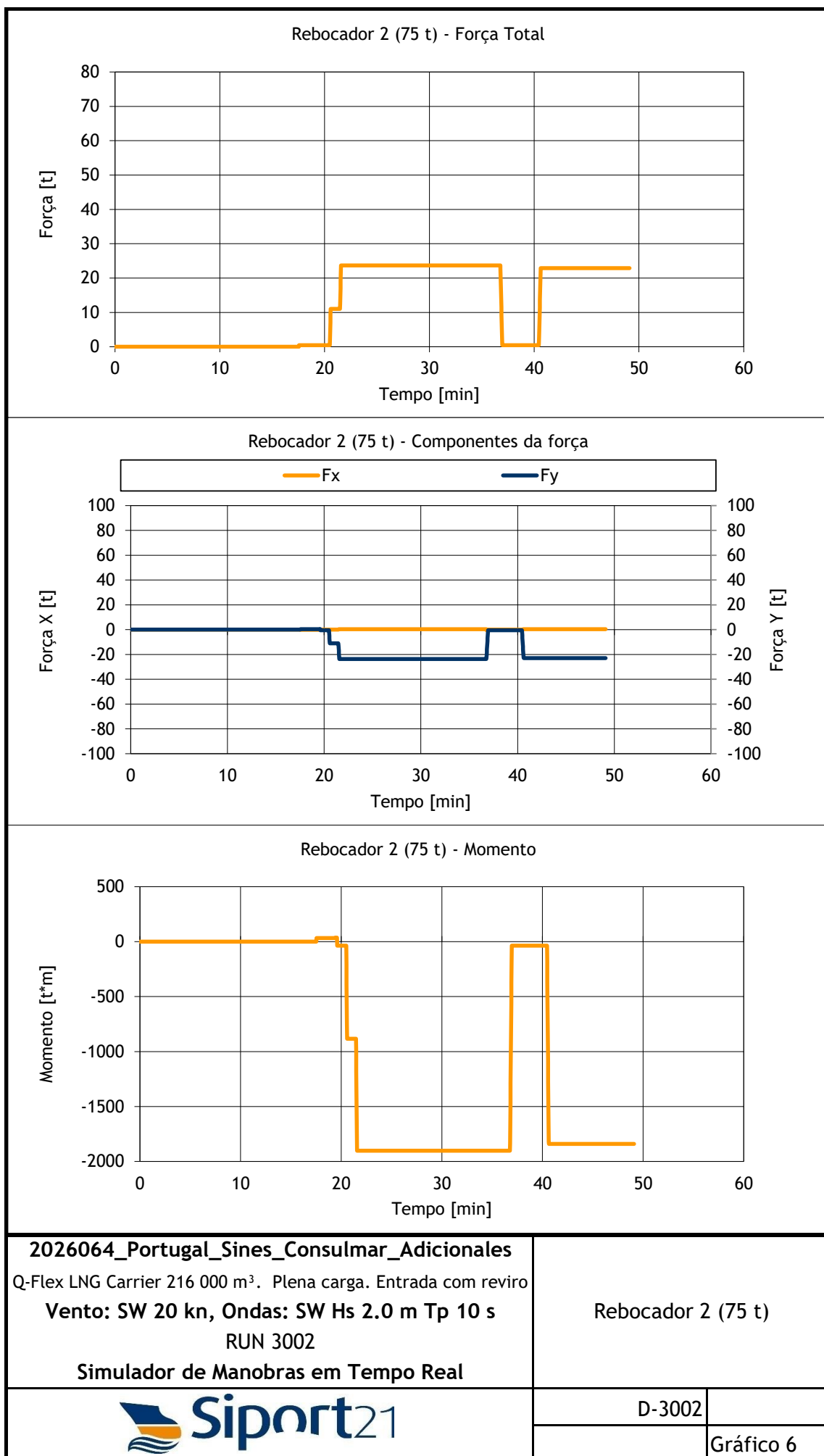


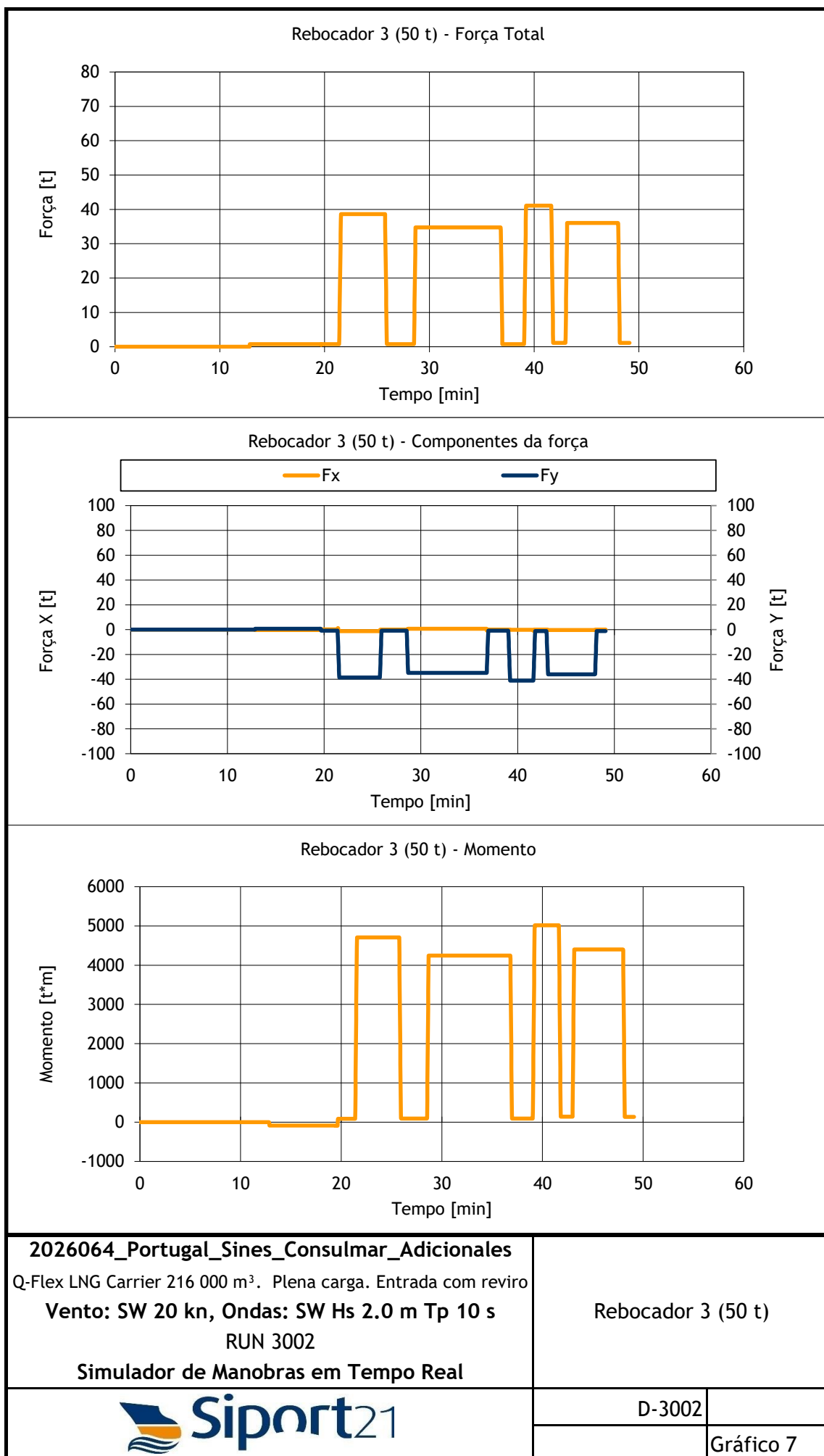
D-3002

Gráfico 3

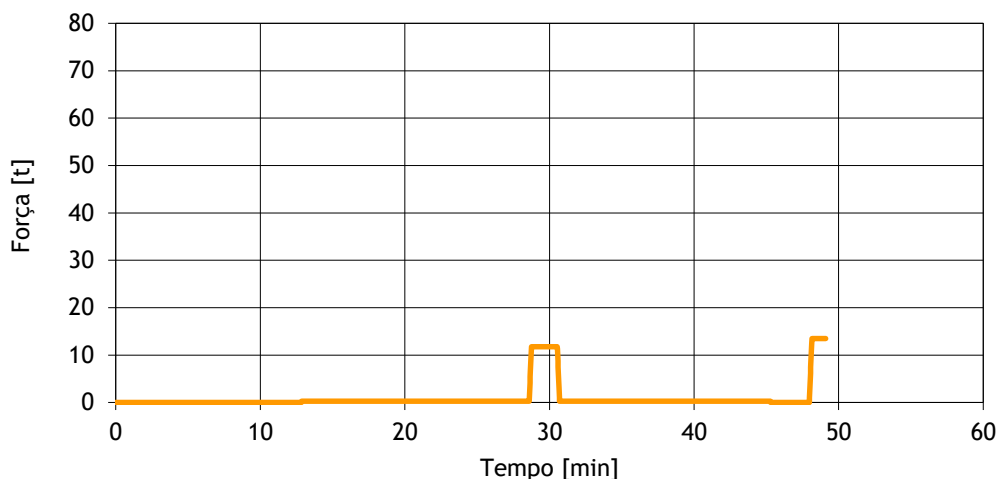




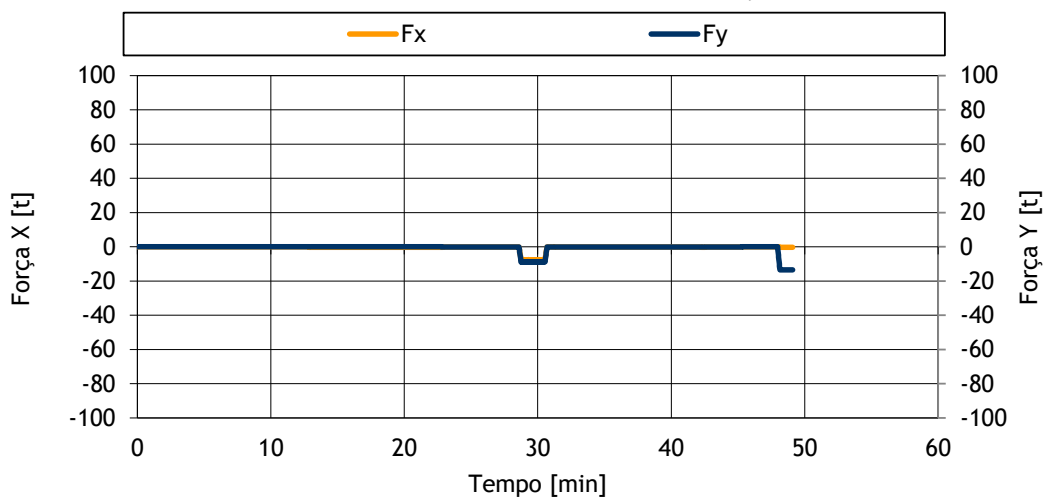




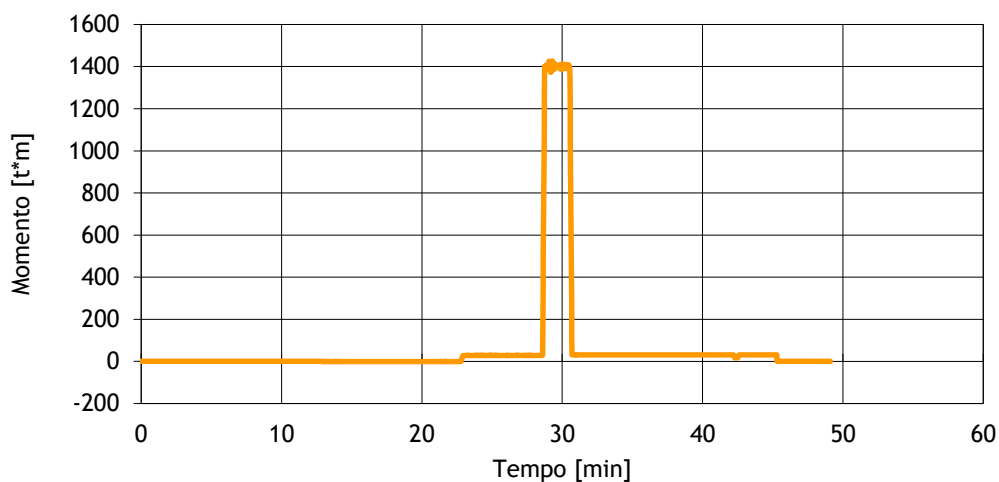
Rebocador 4 (25 t) - Força Total



Rebocador 4 (25 t) - Componentes da força



Rebocador 4 (25 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reeiro

Vento: SW 20 kn, Ondas: SW Hs 2.0 m Tp 10 s

RUN 3002

Simulador de Manobras em Tempo Real

Rebocador 4 (25 t)



D-3002

Gráfico 8

RUN 1003

**Q-Flex LNG Carrier 216 000 m³. Lastro. Saída
direta**

Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

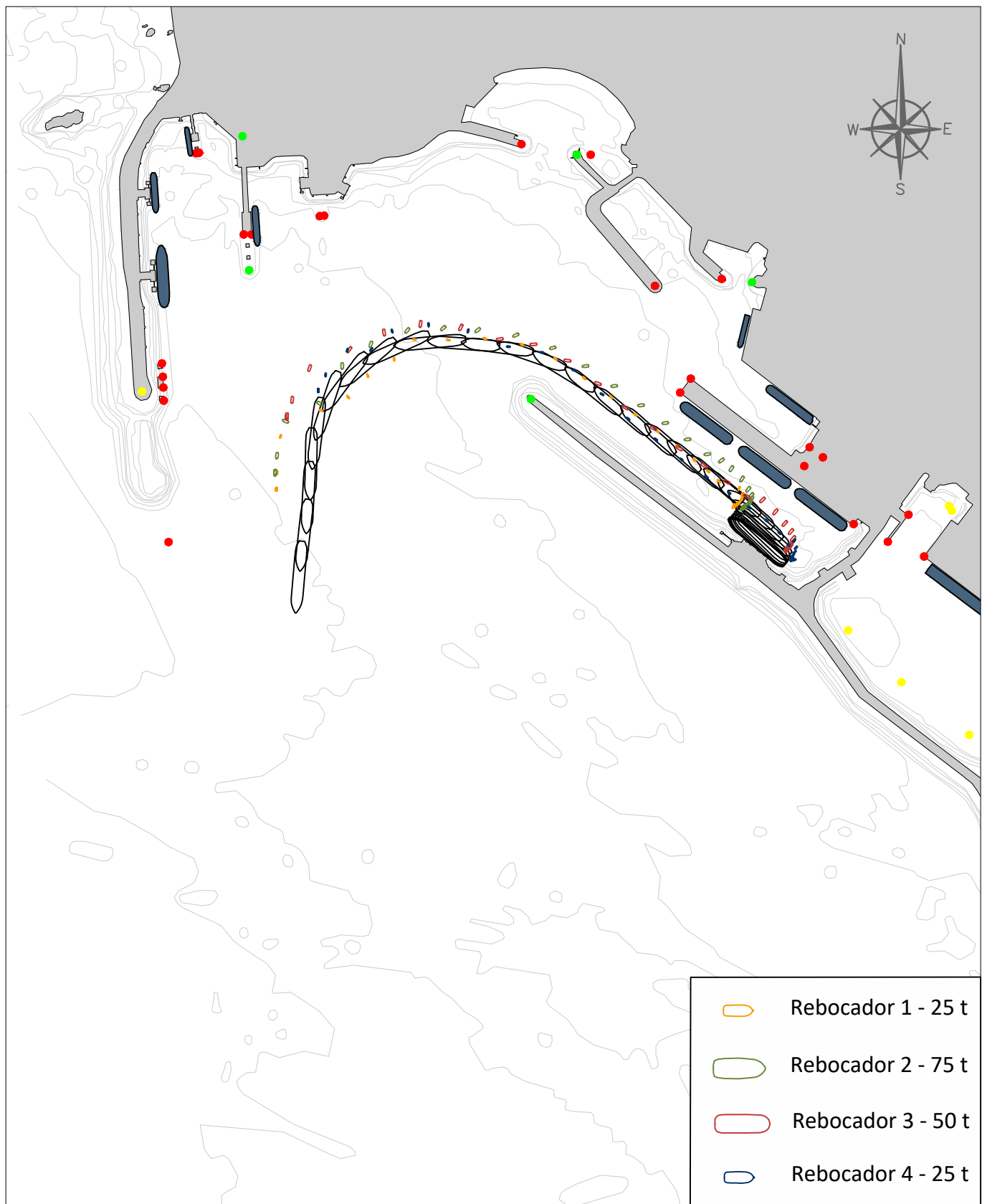


Figure: Trk-1003

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 6 000

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales

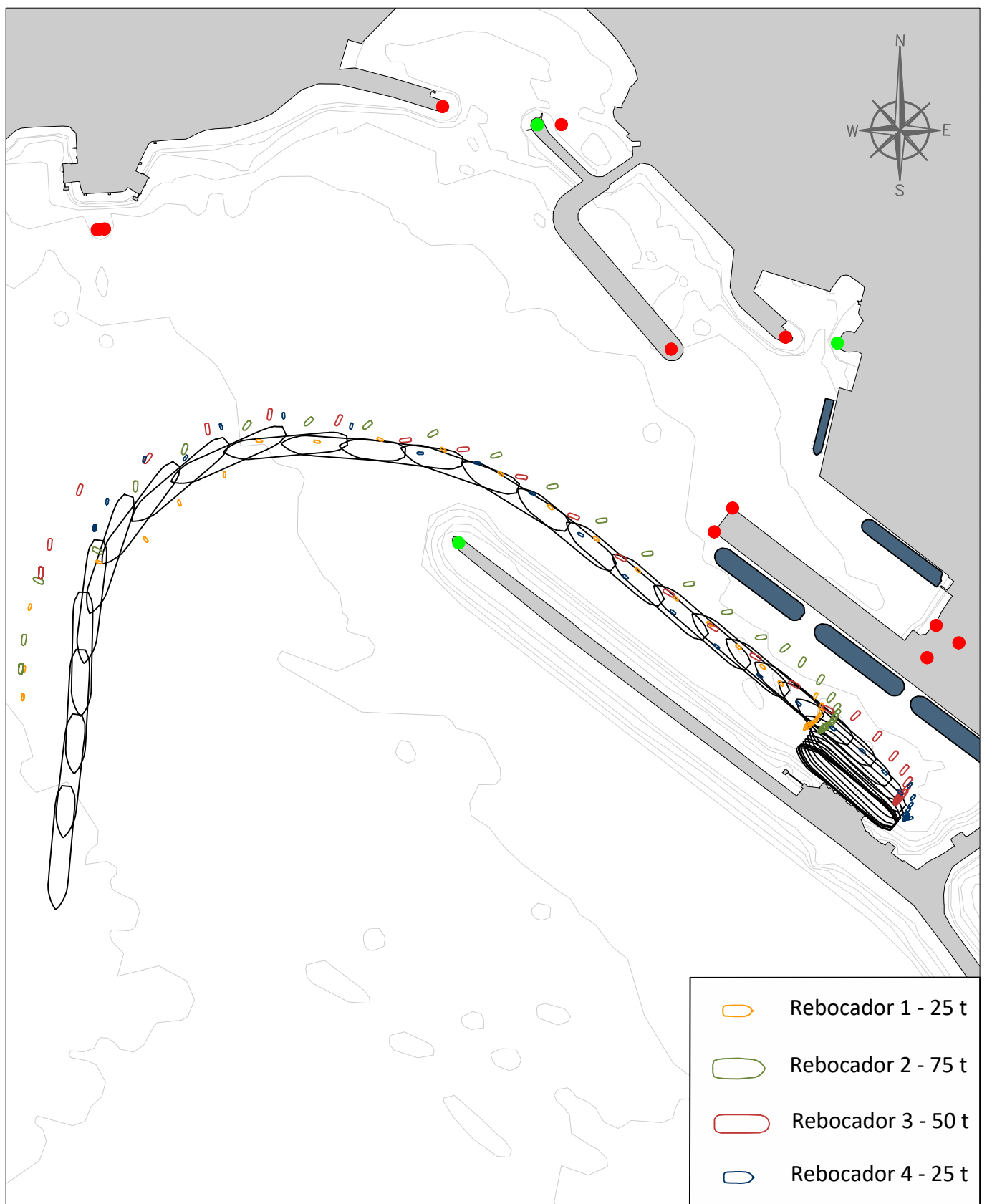


Figure: Trk-1003

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

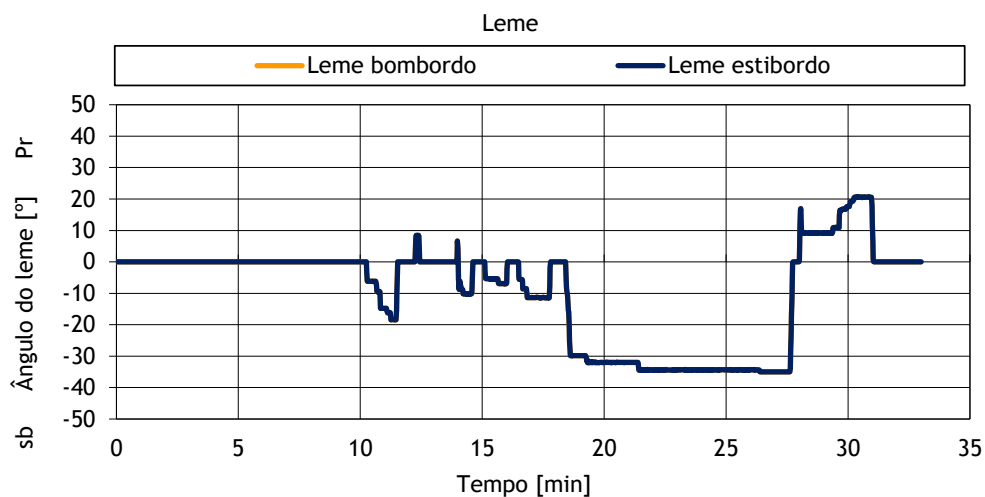
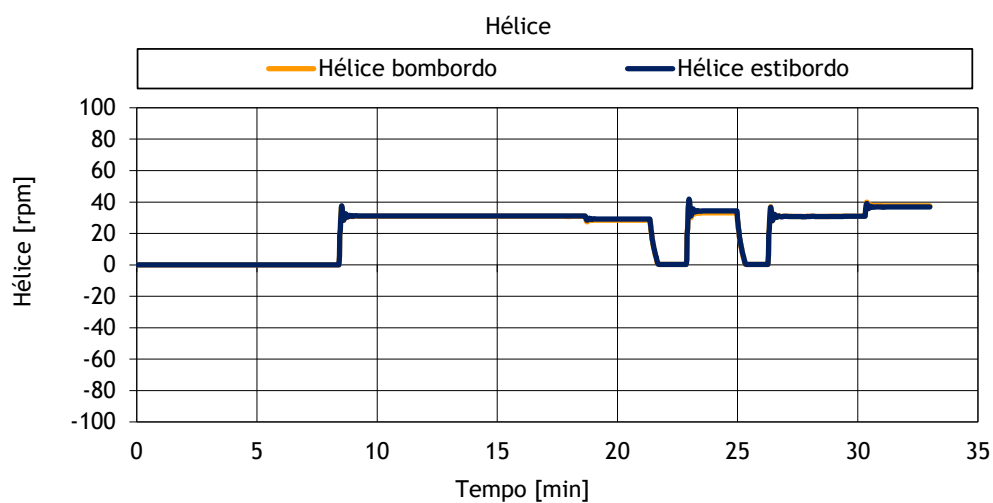
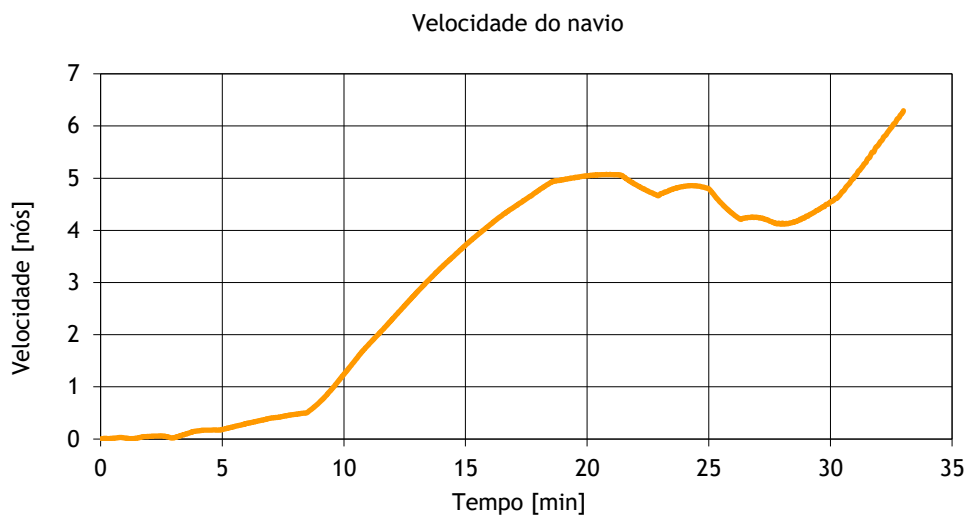
Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 3 500

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales



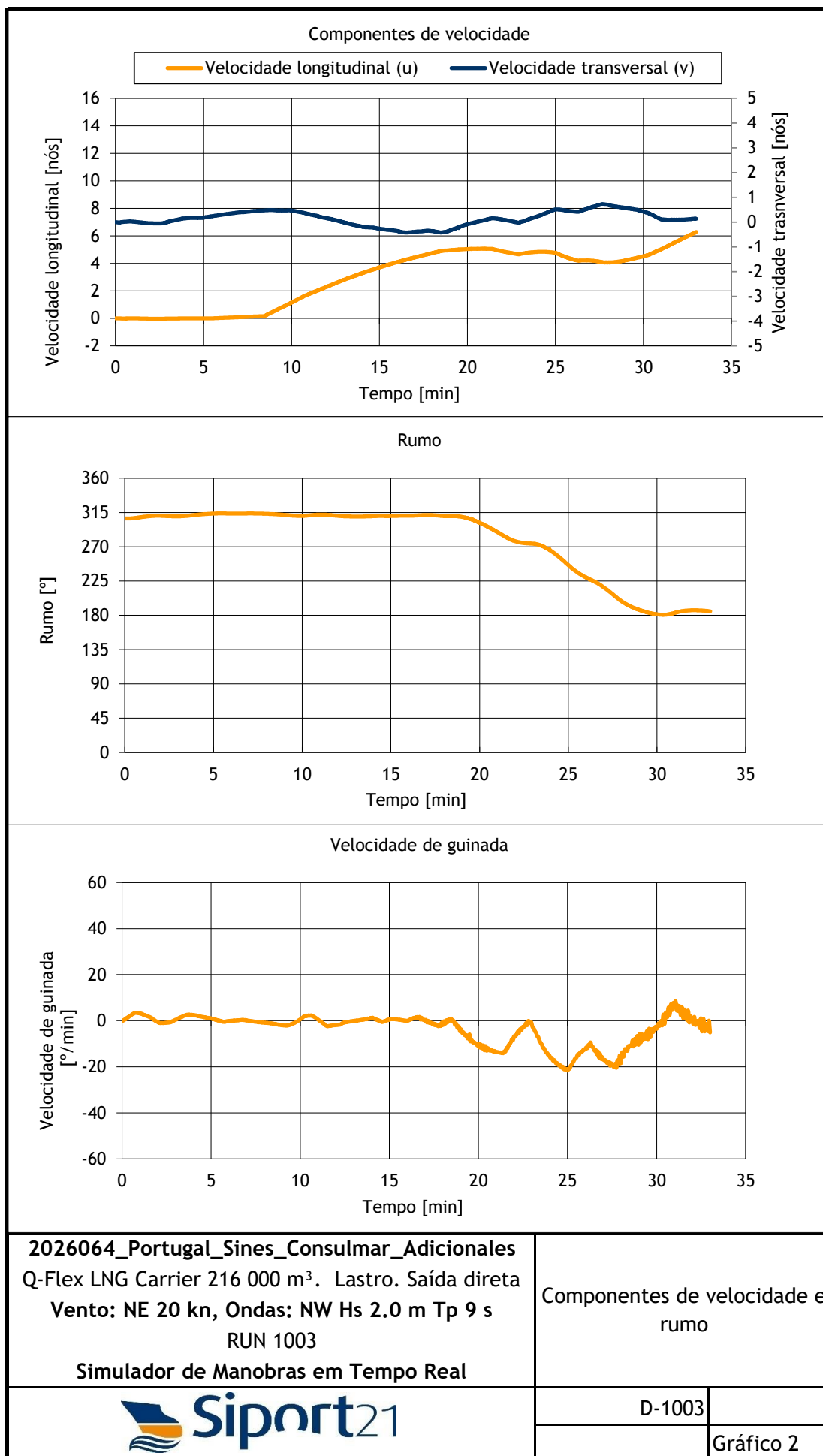
2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
 Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s
 RUN 1003
 Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

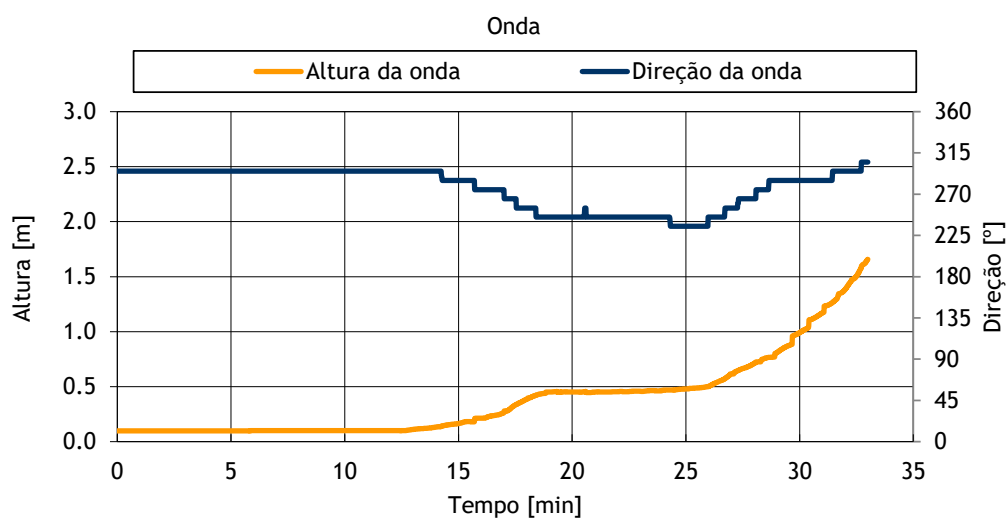
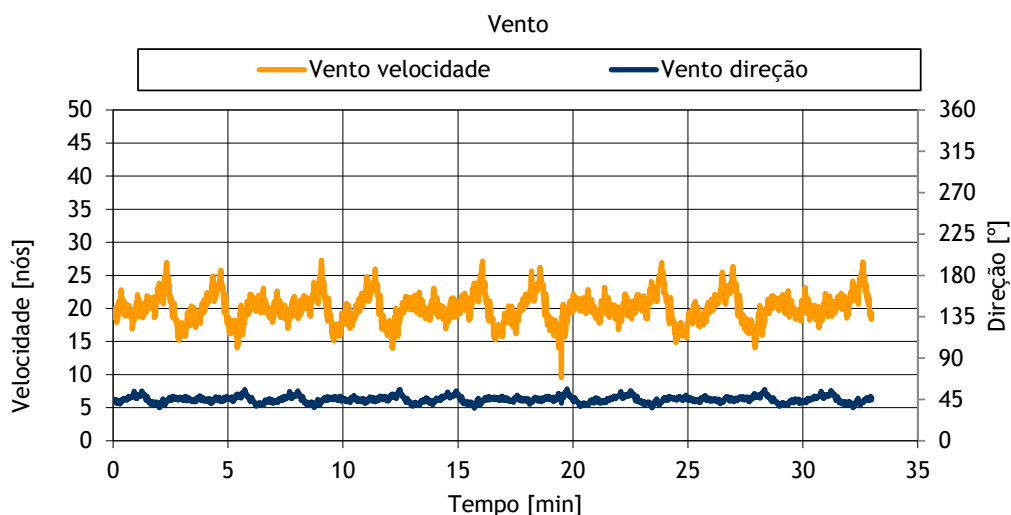
Velocidade, hélice e leme



D-1003

Gráfico 1





2026064_Portugal_Sines_Consulmar_Adicionales
Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 1003

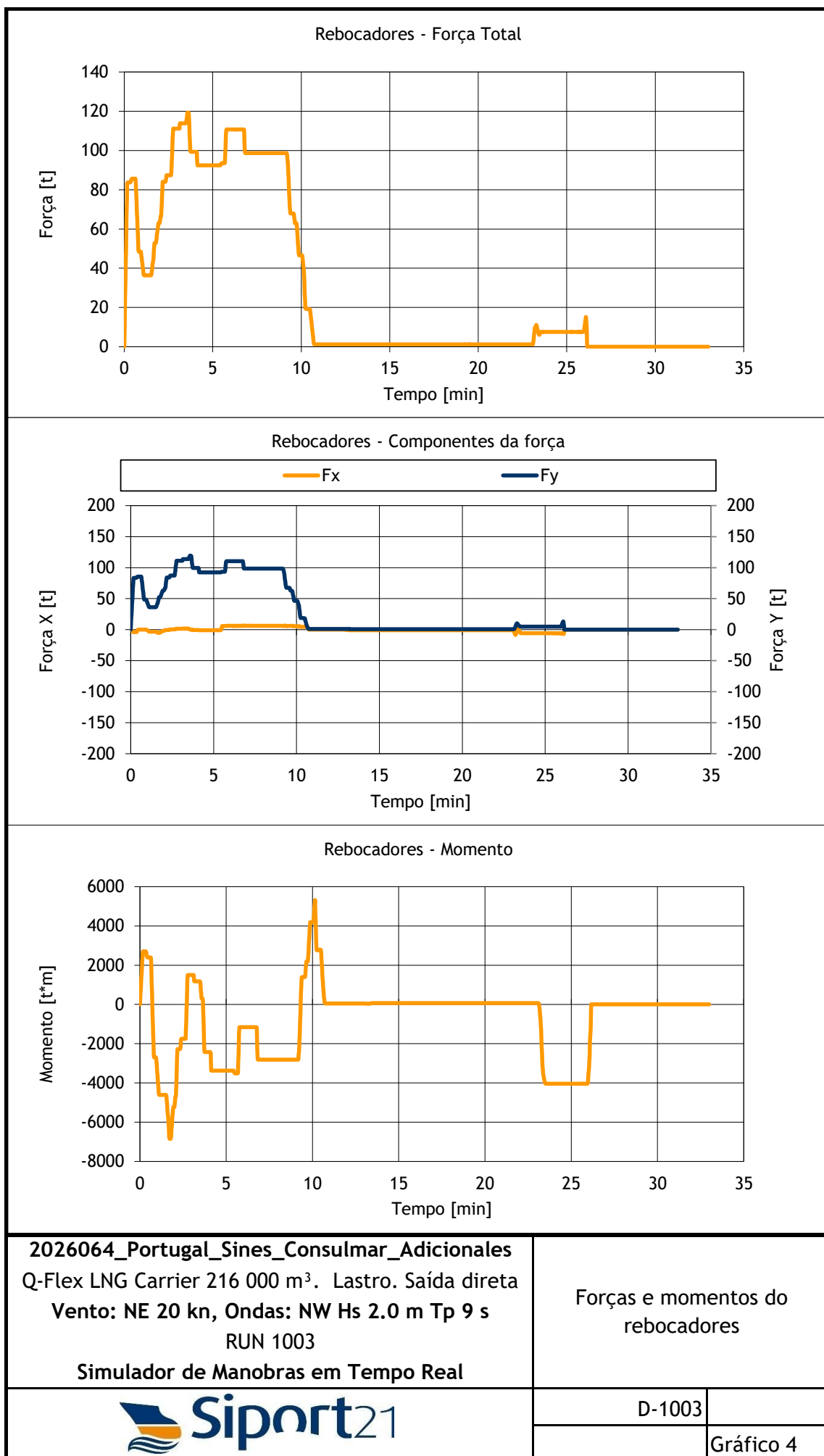
Simulador de Manobras em Tempo Real

Condições climáticas

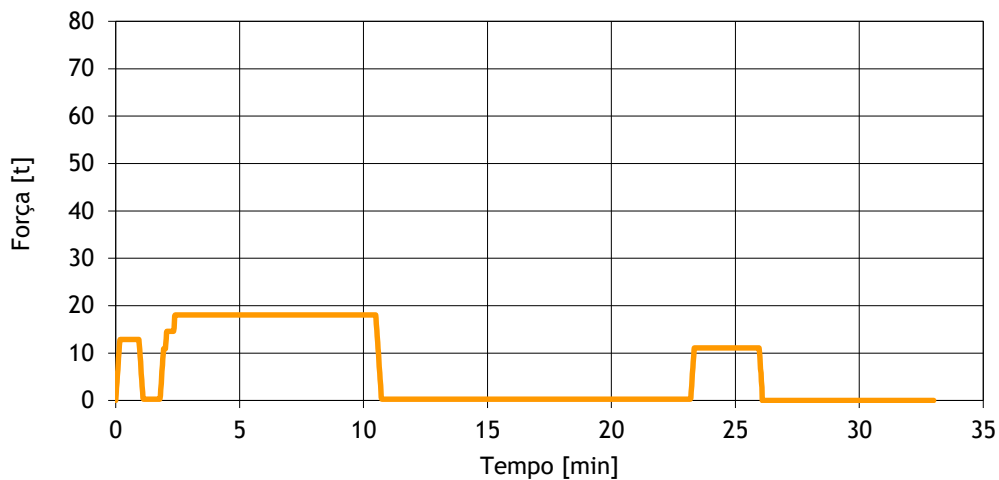


D-1003

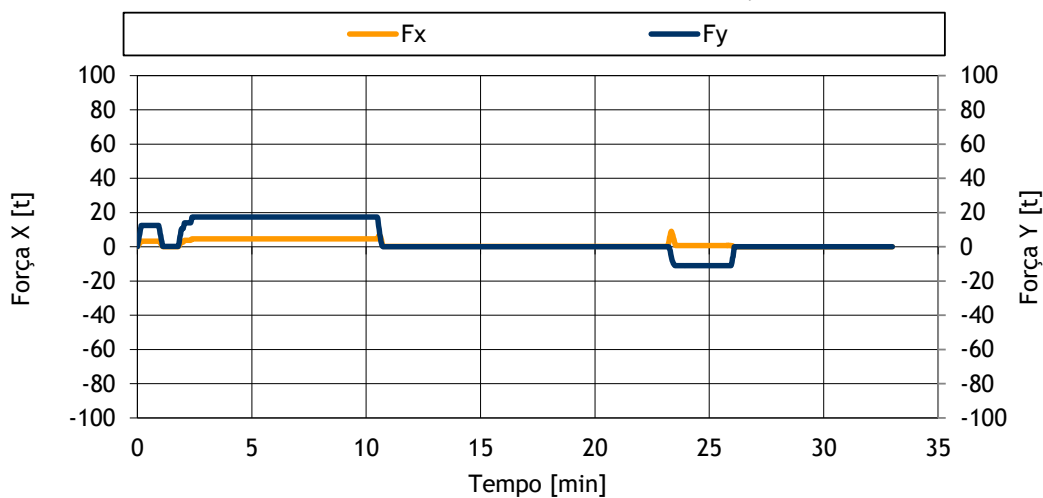
Gráfico 3



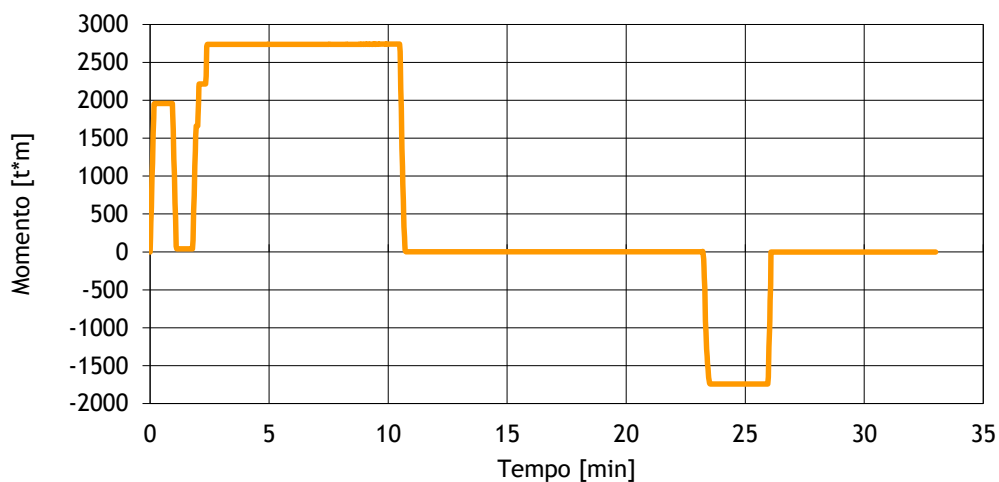
Rebocador 1 (25 t) - Força Total



Rebocador 1 (25 t) - Componentes da força



Rebocador 1 (25 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
 Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s
 RUN 1003
 Simulador de Manobras em Tempo Real

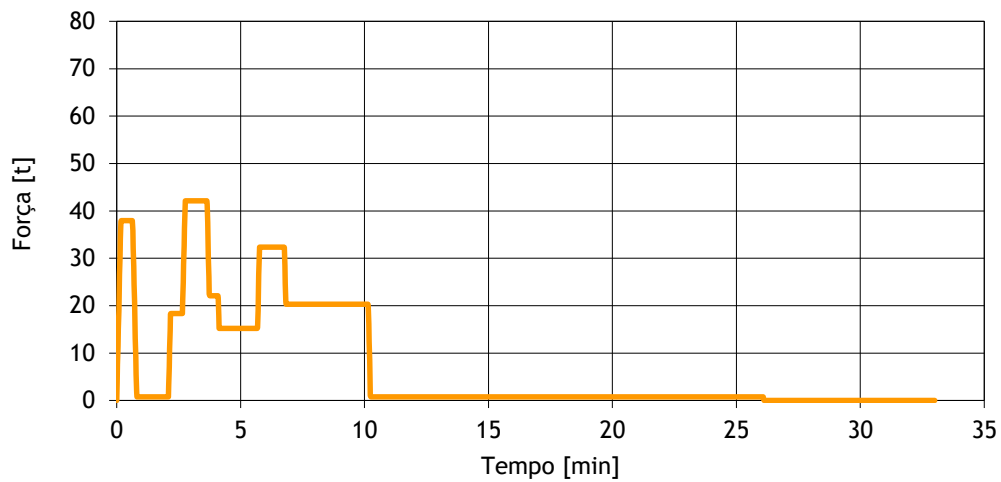
Rebocador 1 (25 t)



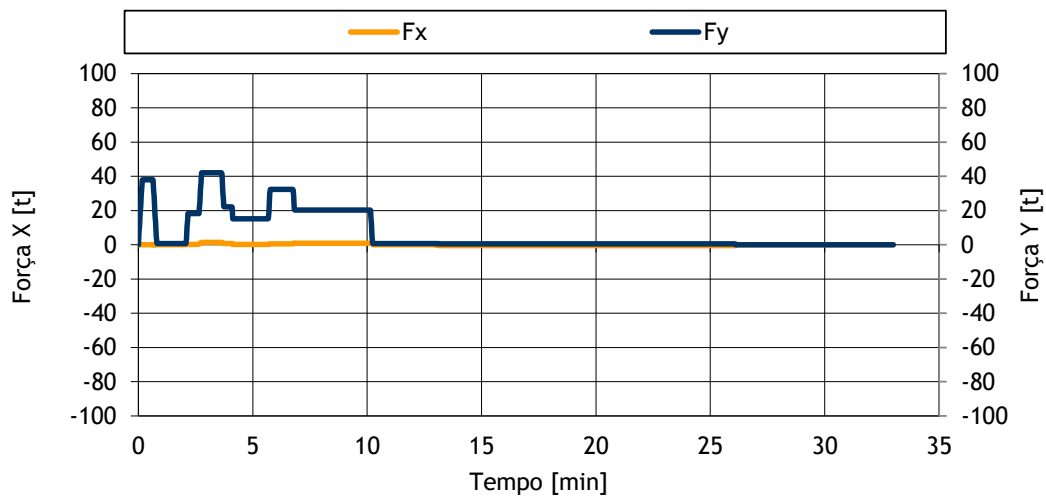
D-1003

Gráfico 5

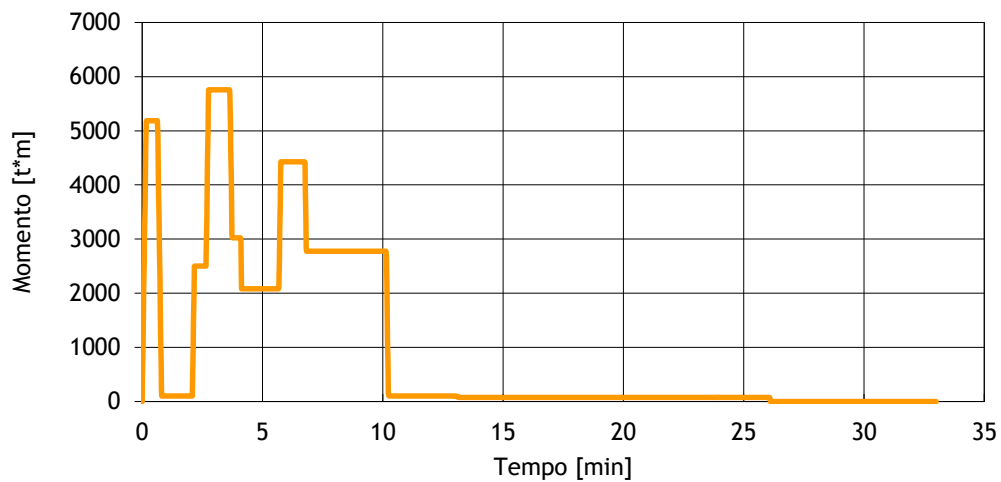
Rebocador 2 (75 t) - Força Total



Rebocador 2 (75 t) - Componentes da força



Rebocador 2 (75 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
 Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s
 RUN 1003
 Simulador de Manobras em Tempo Real

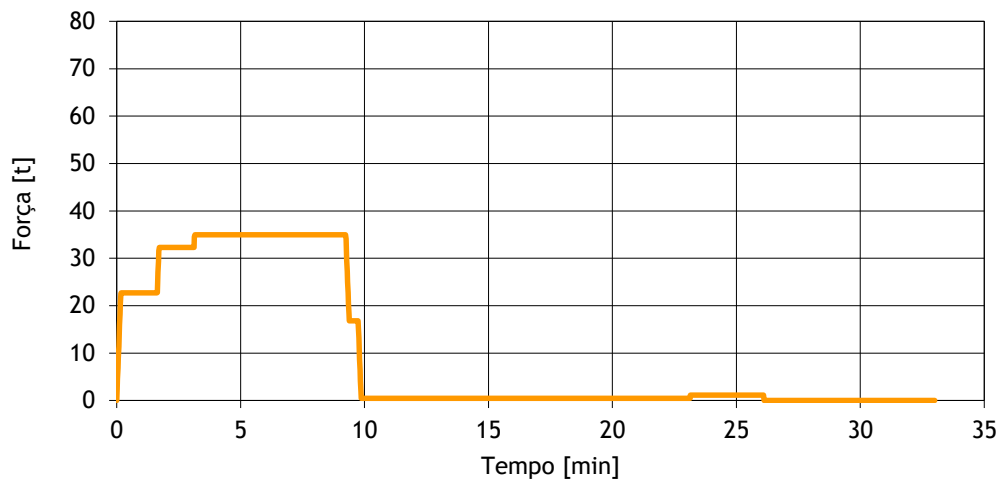
Rebocador 2 (75 t)



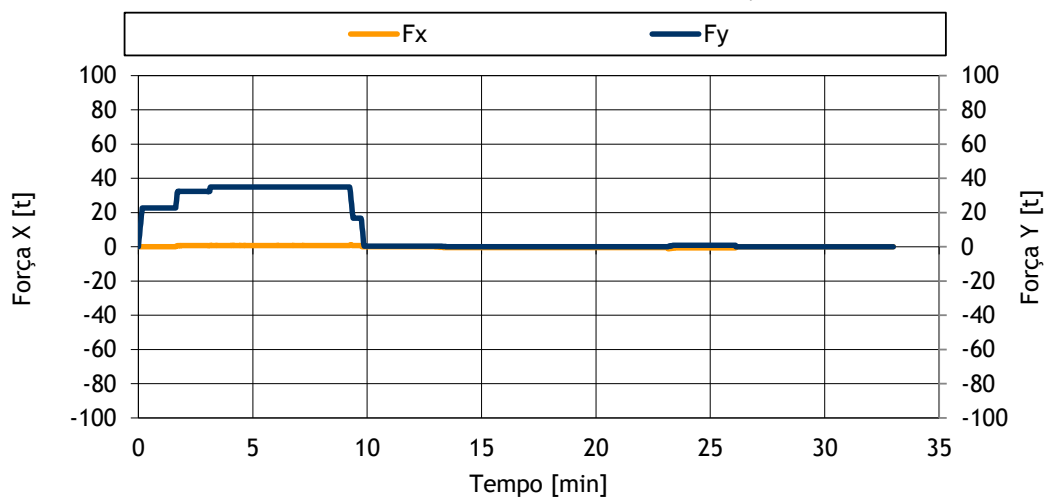
D-1003

Gráfico 6

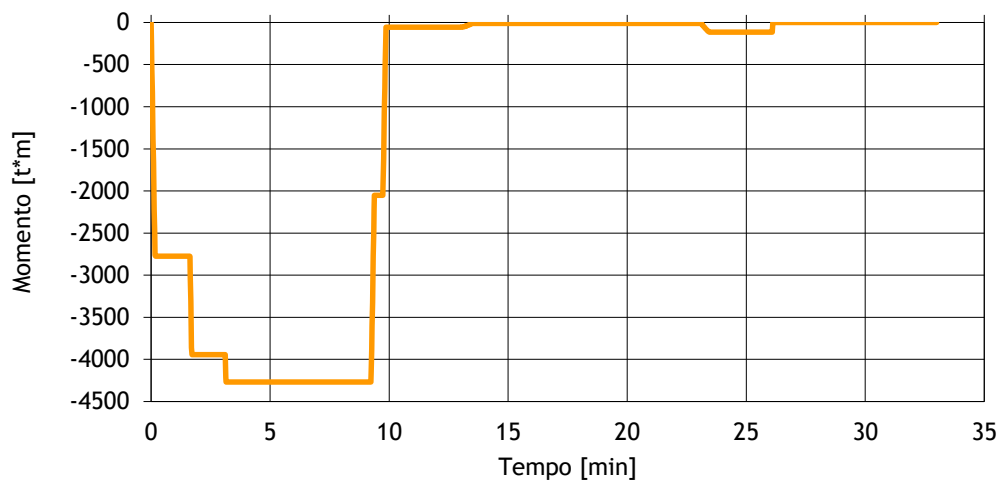
Rebocador 3 (50 t) - Força Total



Rebocador 3 (50 t) - Componentes da força



Rebocador 3 (50 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
 Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s
 RUN 1003
 Simulador de Manobras em Tempo Real

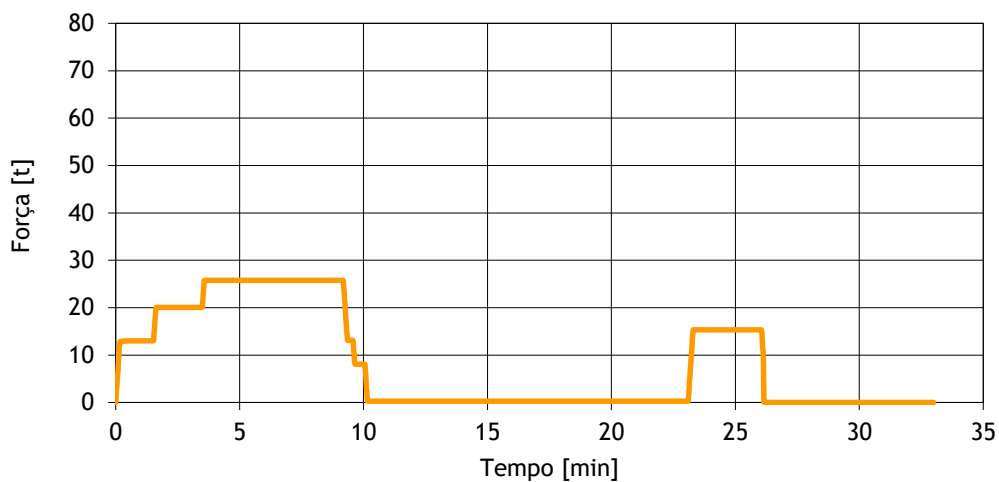
Rebocador 3 (50 t)



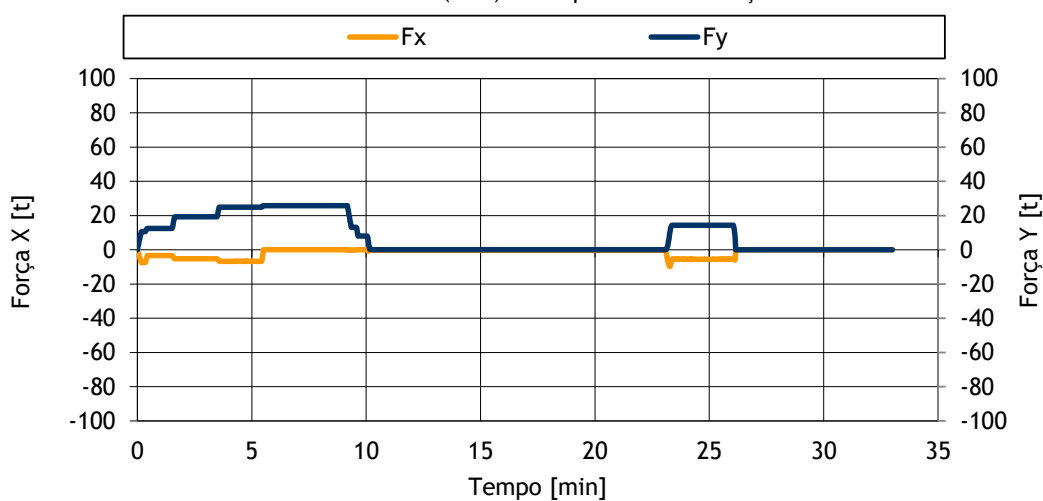
D-1003

Gráfico 7

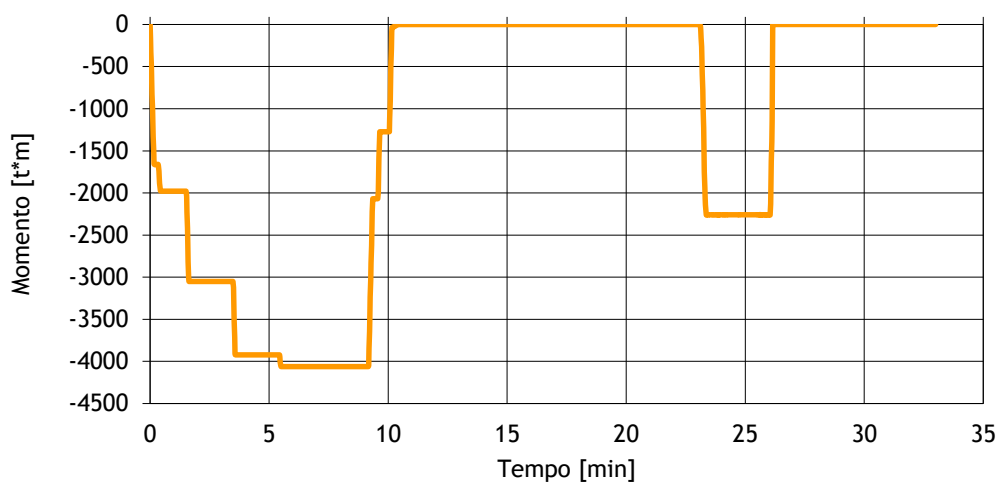
Rebocador 4 (25 t) - Força Total



Rebocador 4 (25 t) - Componentes da força



Rebocador 4 (25 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NE 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 1003

Simulador de Manobras em Tempo Real

Rebocador 4 (25 t)



D-1003

Gráfico 8

RUN 2003

**Q-Flex LNG Carrier 216 000 m³. Plena carga.
Entrada com reviro**

Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

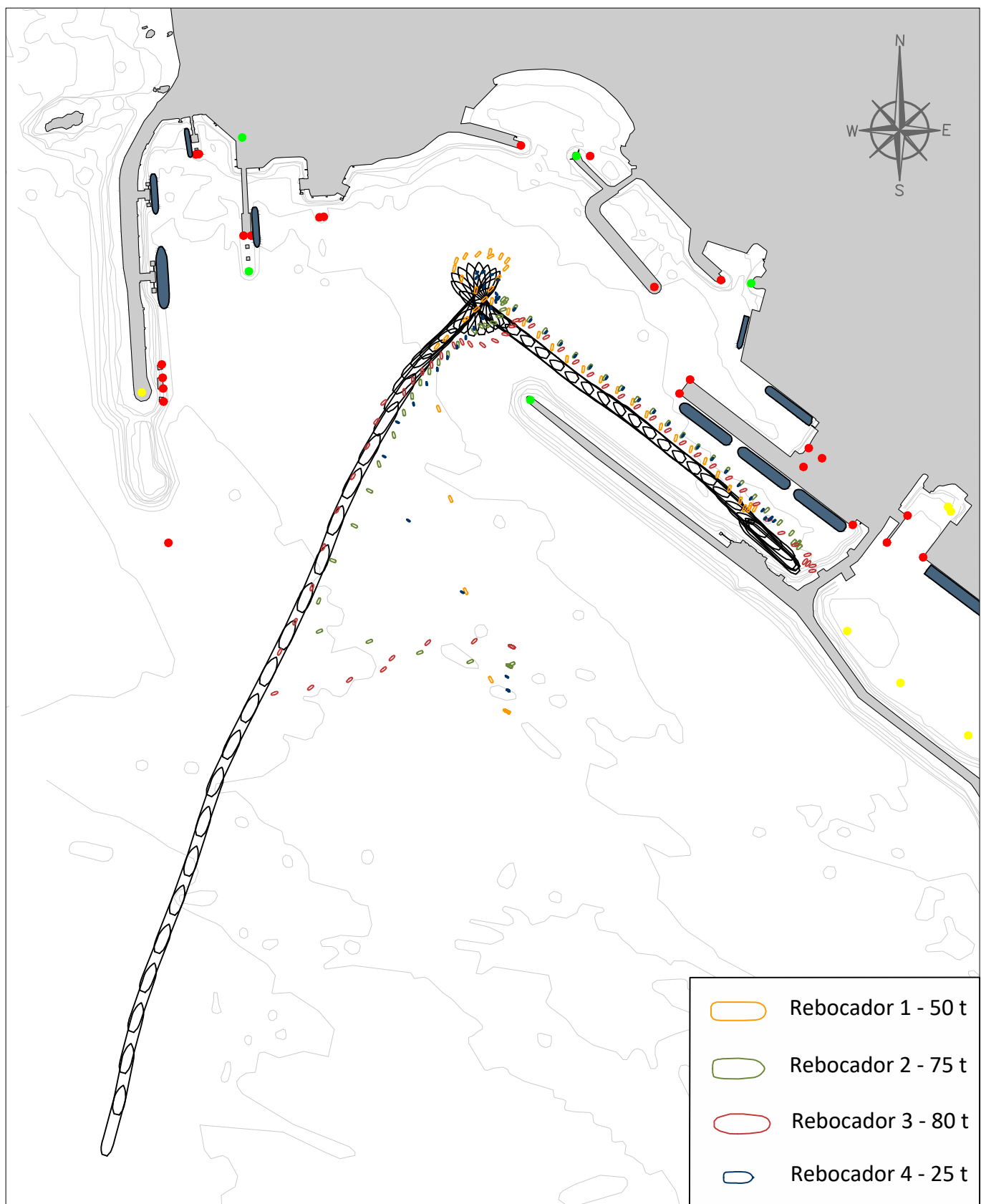


Figure: Trk-2003

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 6 000

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales

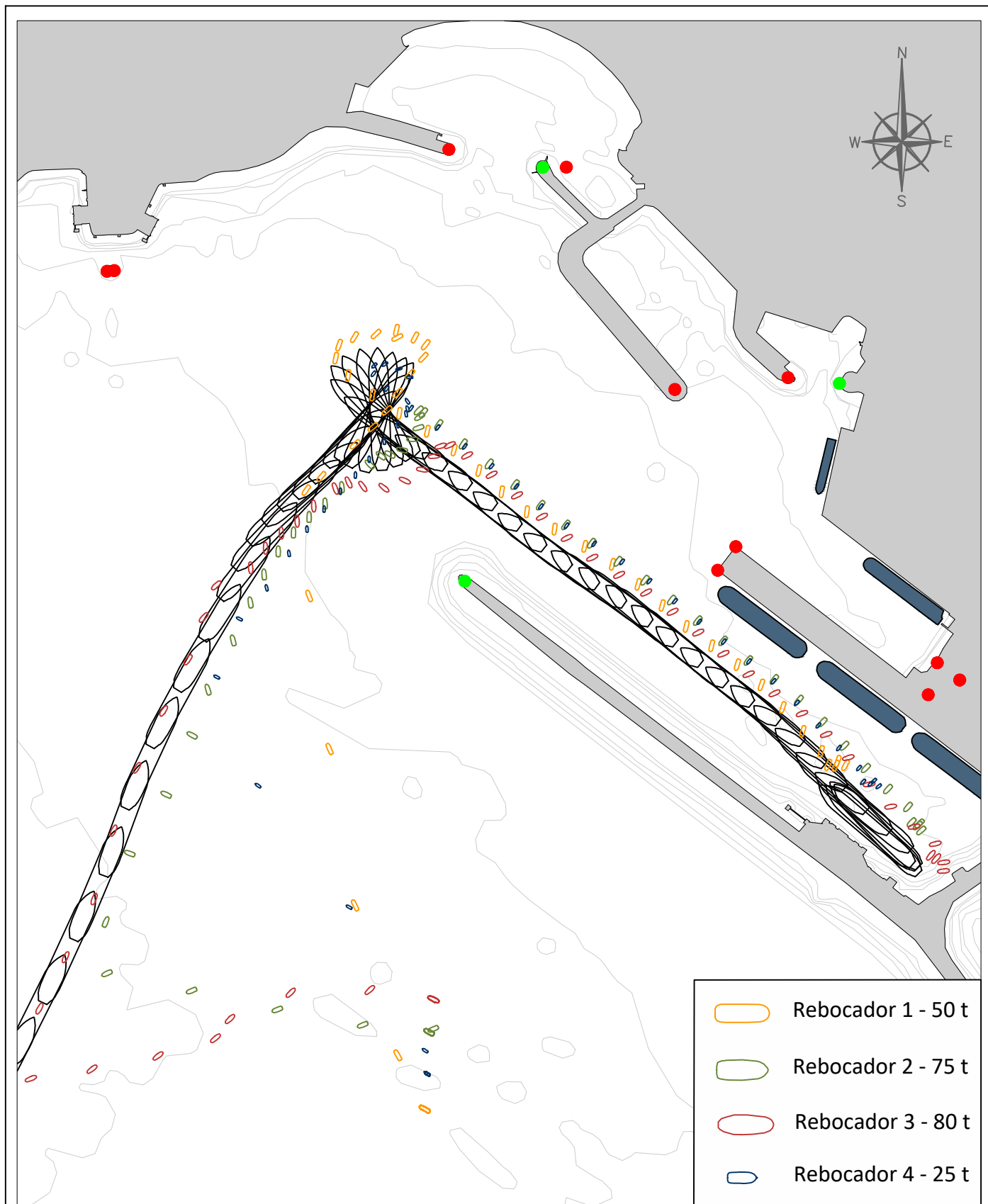


Figure: Trk-2003

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

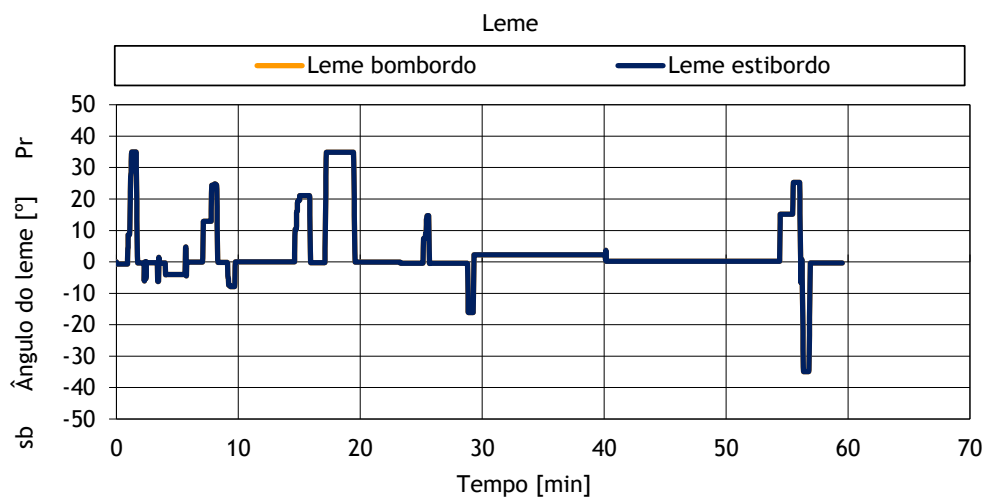
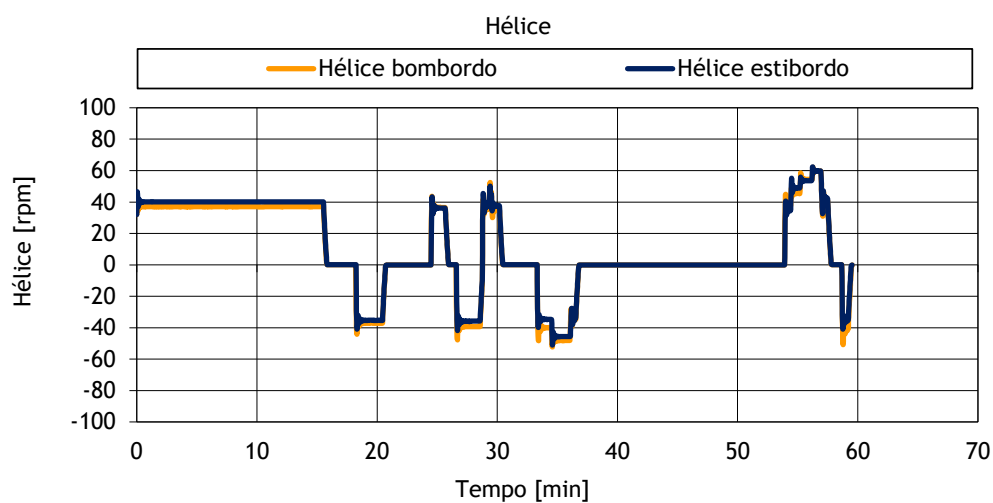
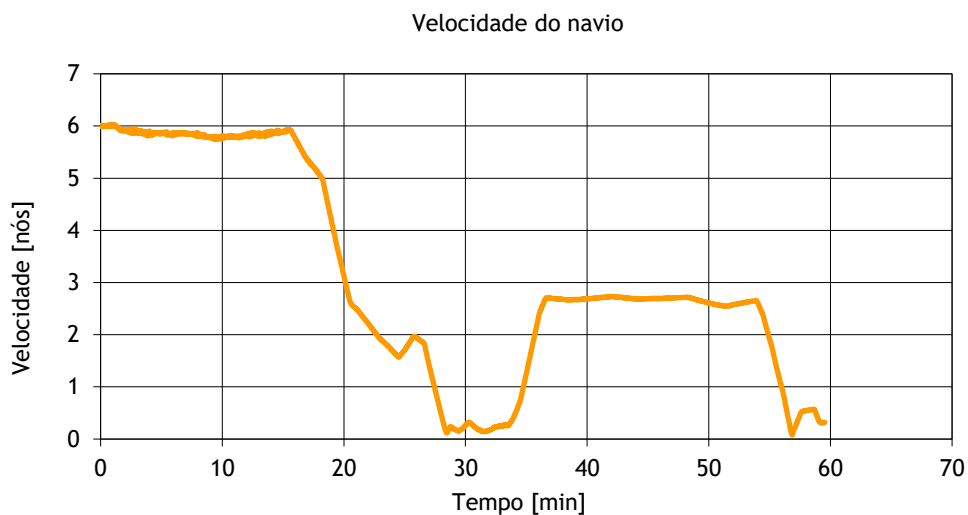
Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 3 500

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 2003

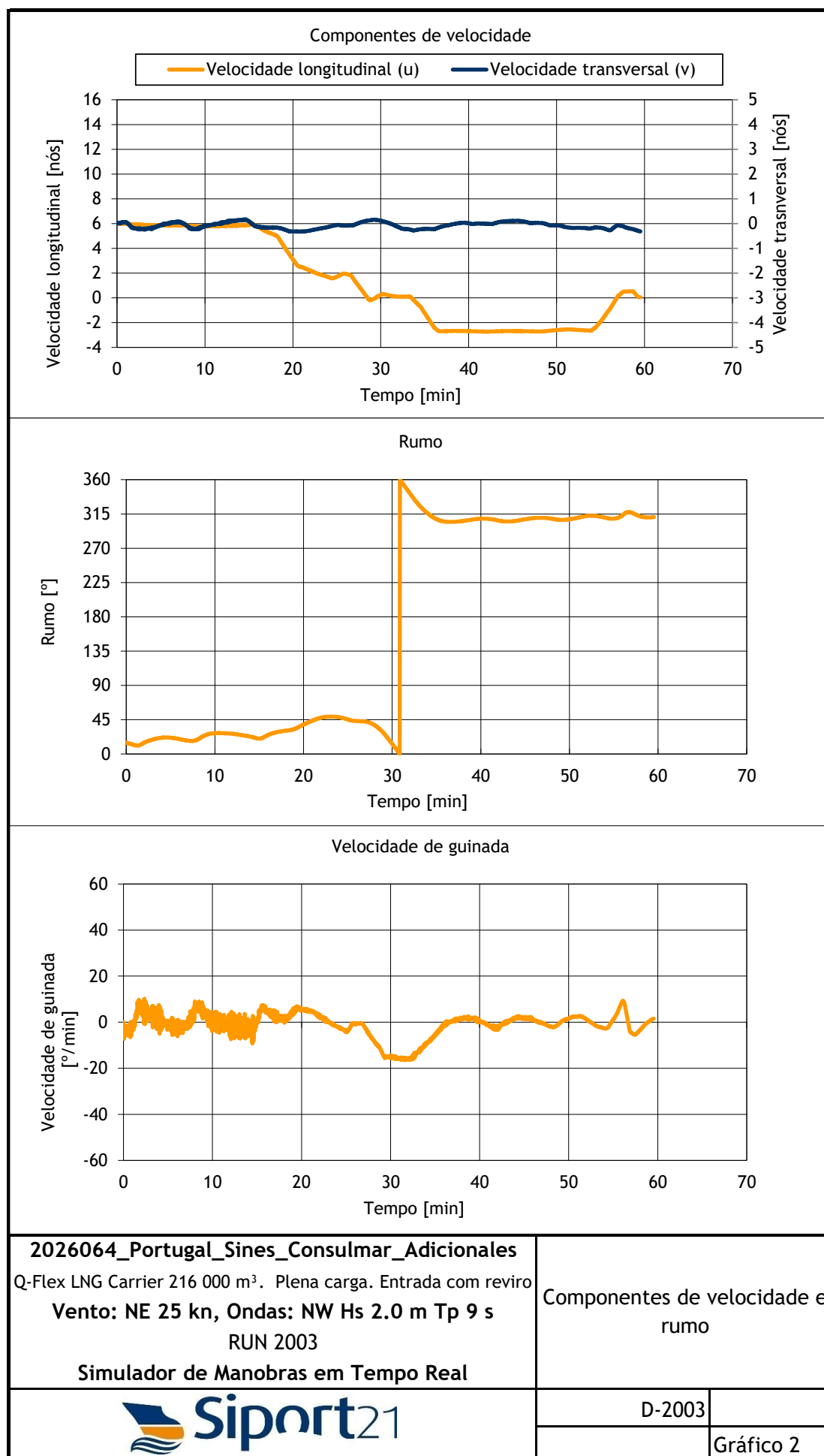
Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

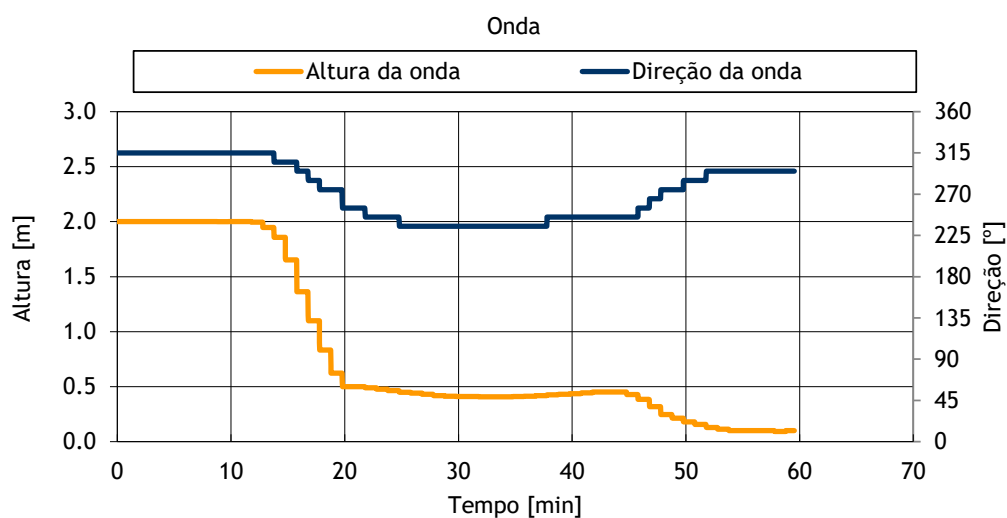
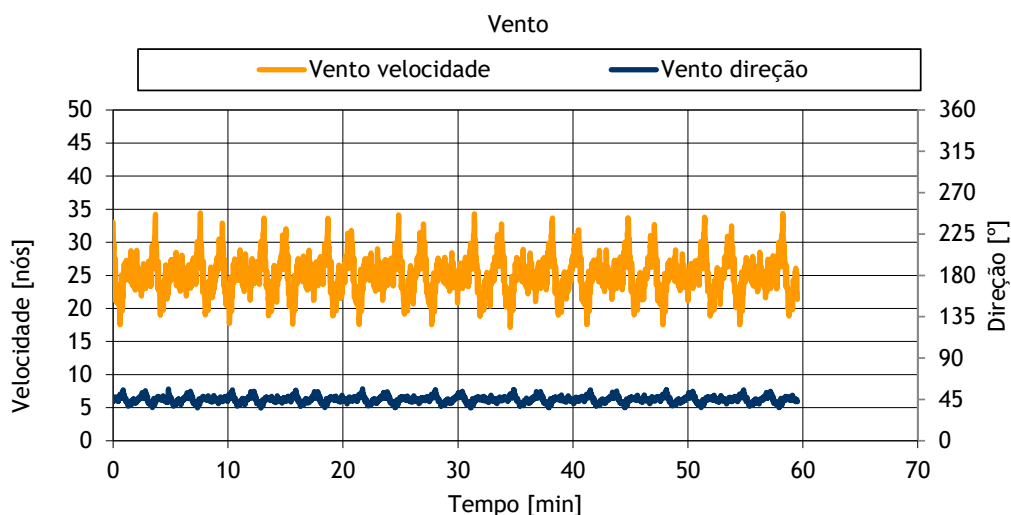
Velocidade, hélice e leme



D-2003

Gráfico 1





2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 2003

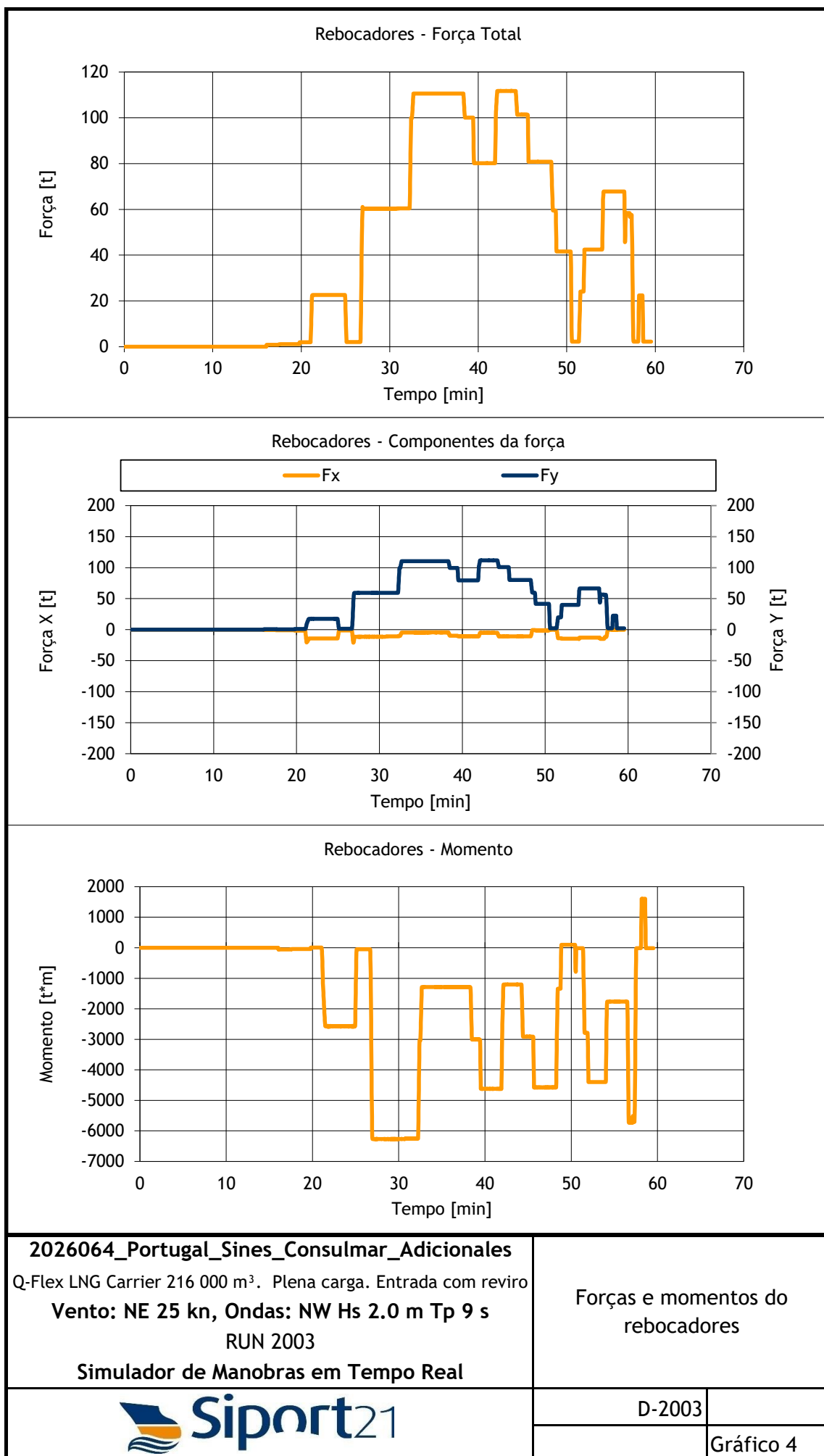
Simulador de Manobras em Tempo Real

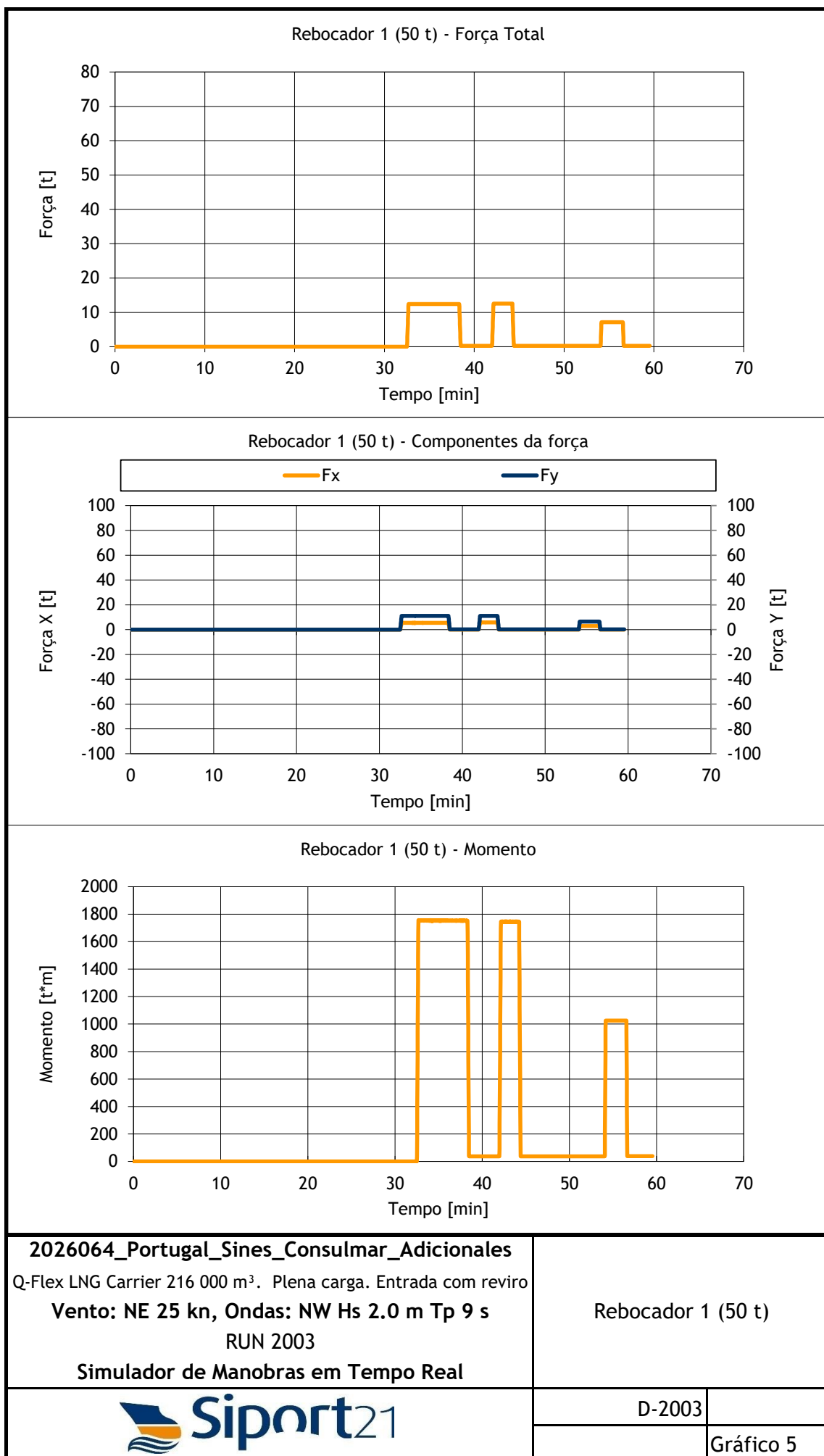
Condições climáticas

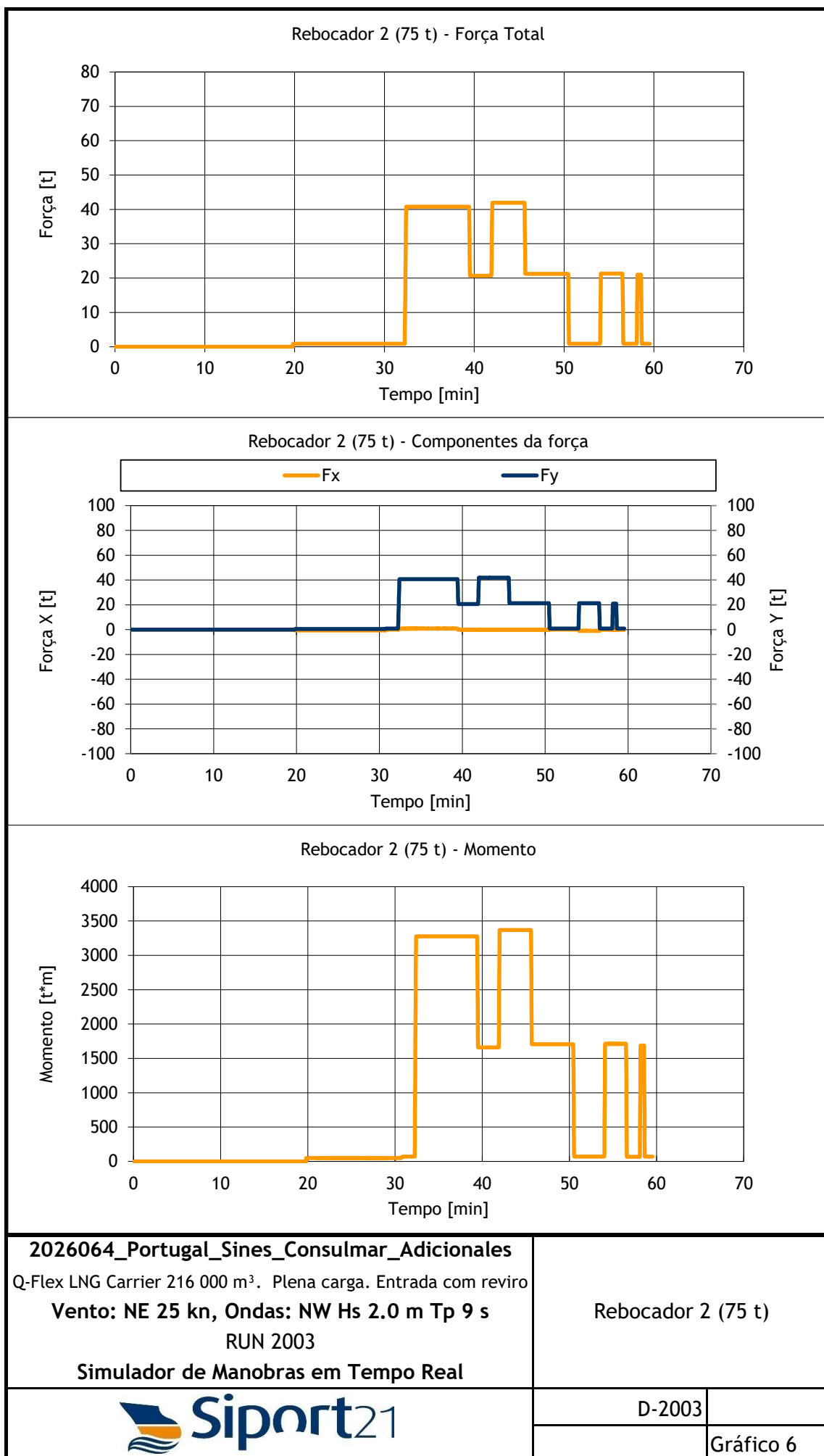


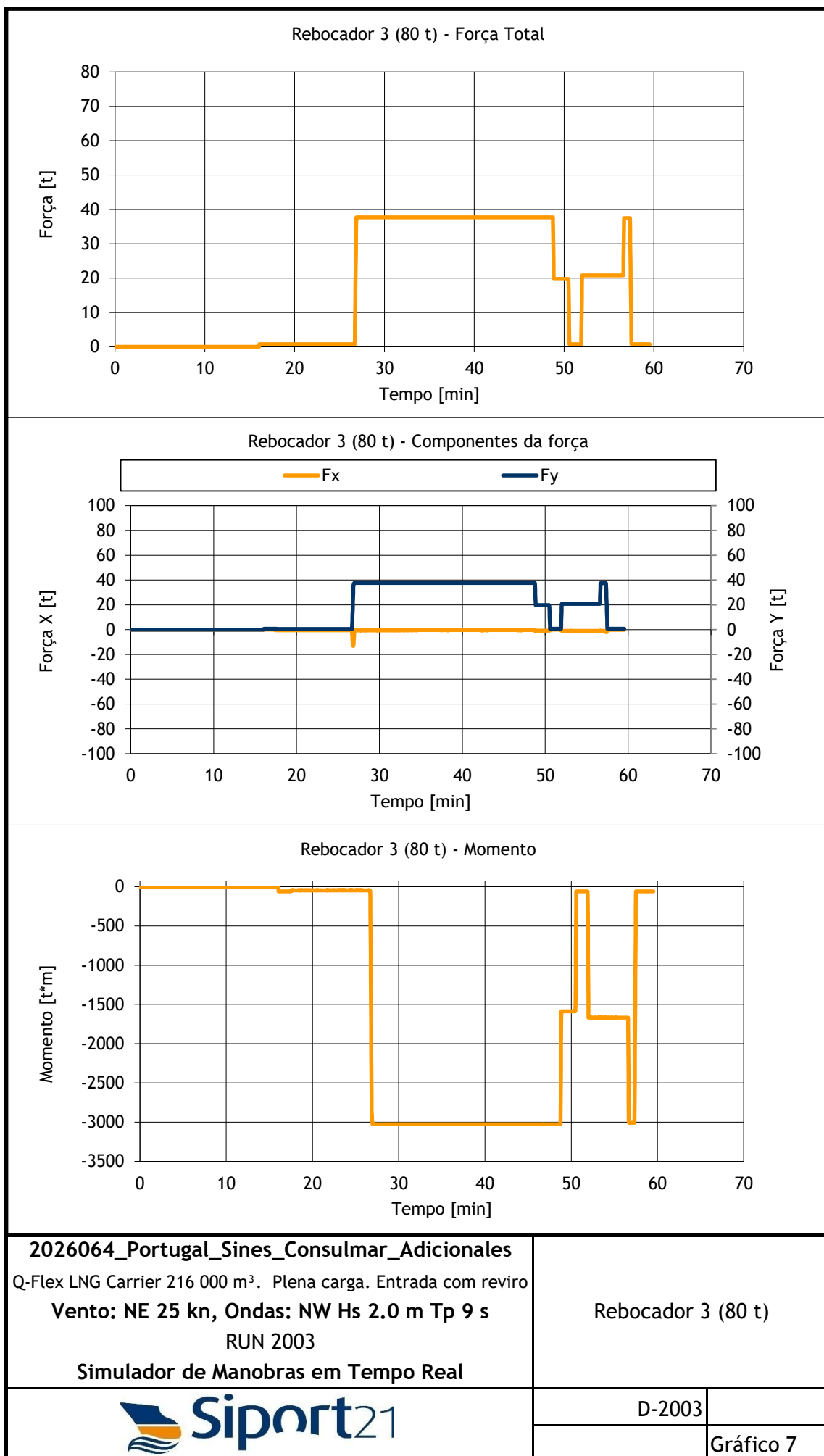
D-2003

Gráfico 3

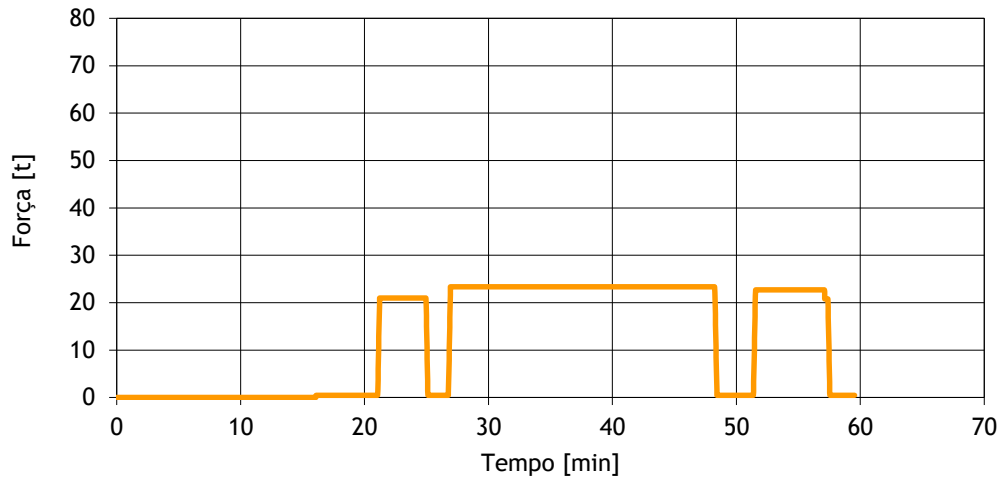




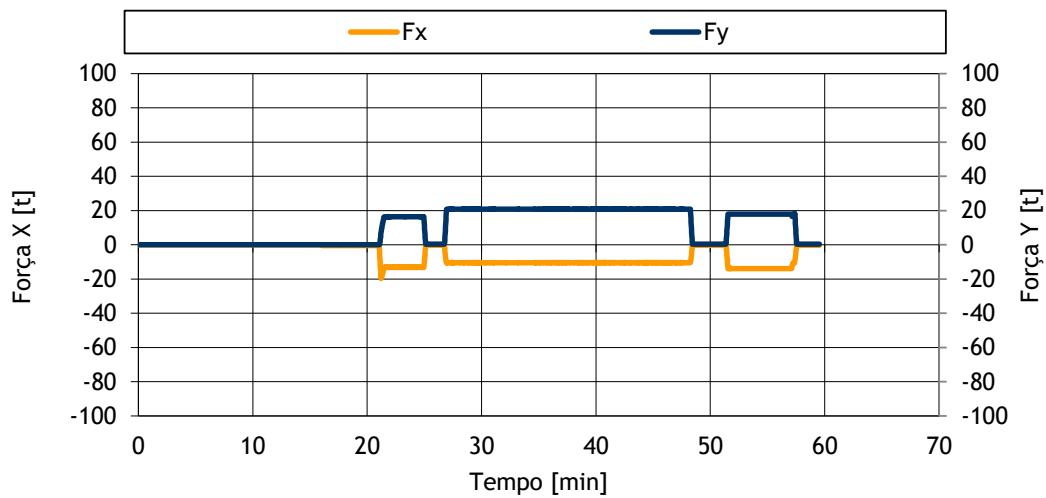




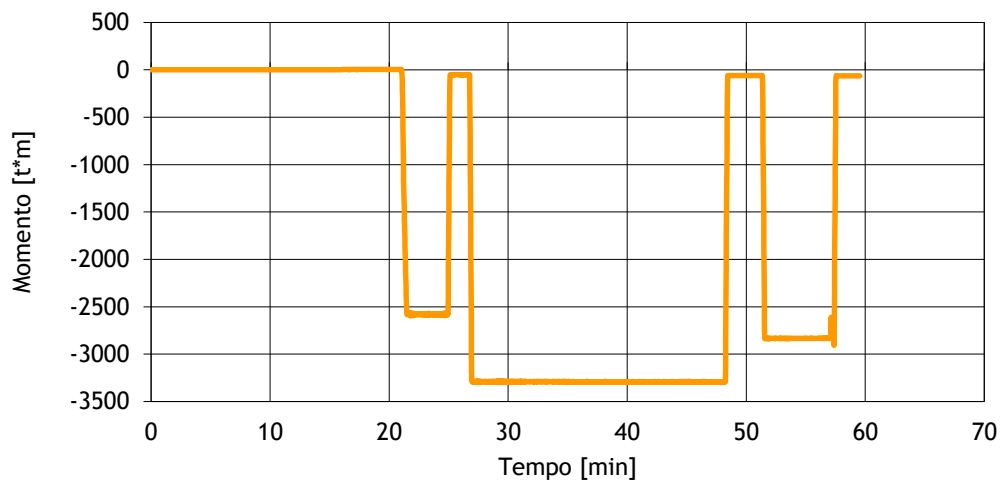
Rebocador 4 (25 t) - Força Total



Rebocador 4 (25 t) - Componentes da força



Rebocador 4 (25 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Plena carga. Entrada com reviro

Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 2003

Simulador de Manobras em Tempo Real

Rebocador 4 (25 t)



D-2003

Gráfico 8

RUN 2004

**Q-Flex LNG Carrier 216 000 m³. Lastro. Saída
direta**

Vento: SW 20 kn, Ondas: SW Hs 2.0 m Tp 10 s

Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

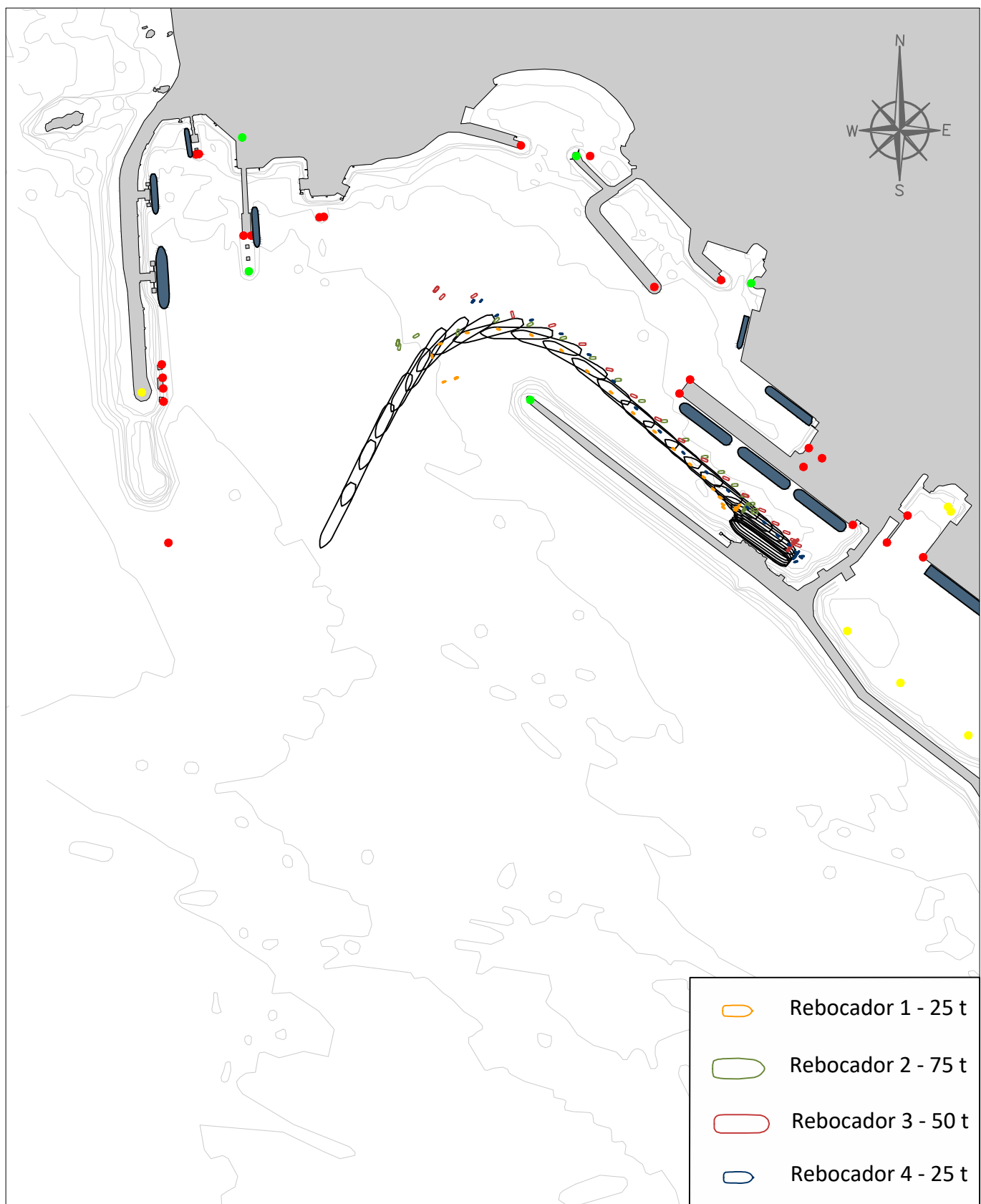


Figure: Trk-2004

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: SW 20 kn, Ondas: SW Hs 2.0 m Tp 10 s

Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 6 000

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales

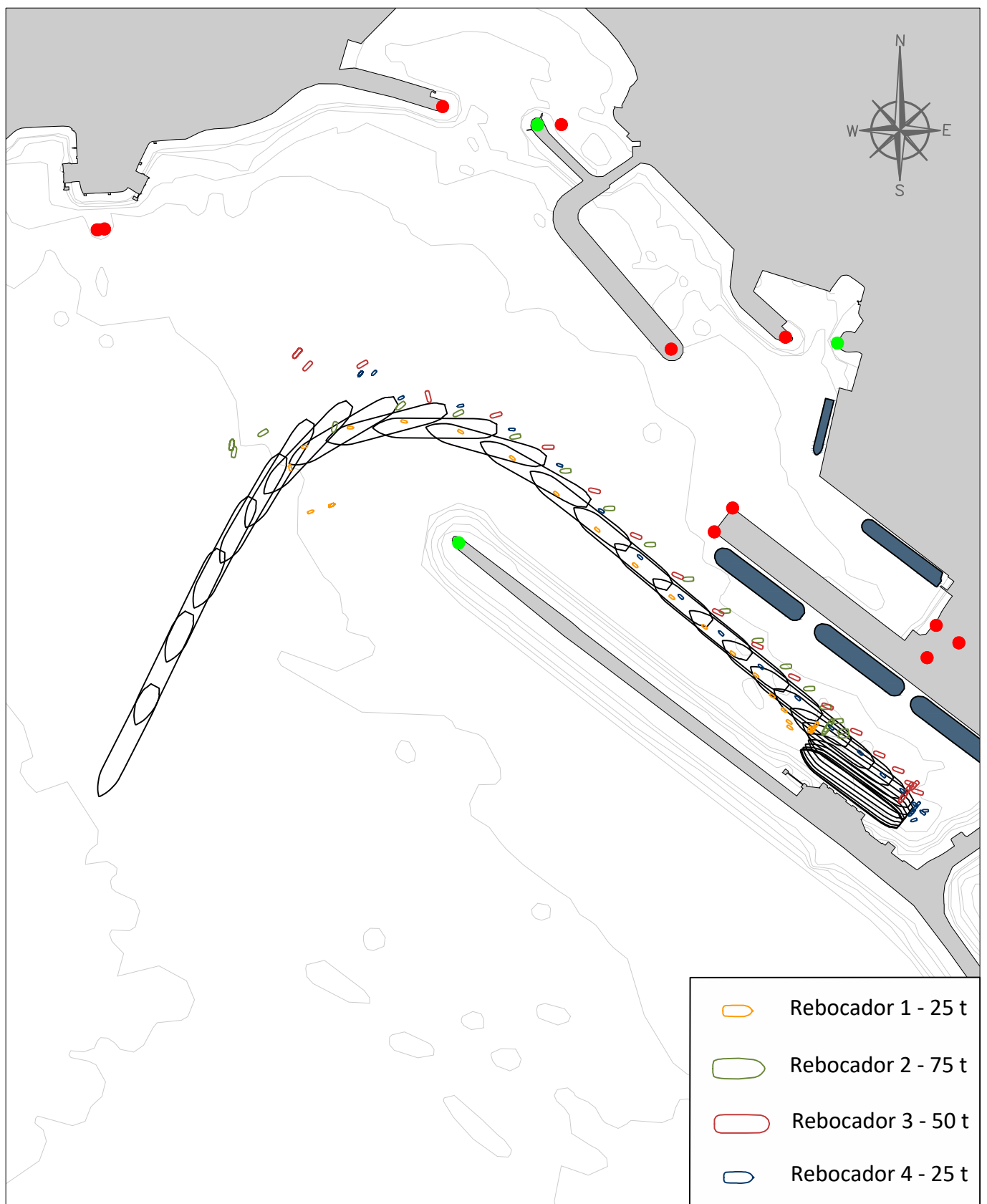


Figure: Trk-2004

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: SW 20 kn, Ondas: SW Hs 2.0 m Tp 10 s

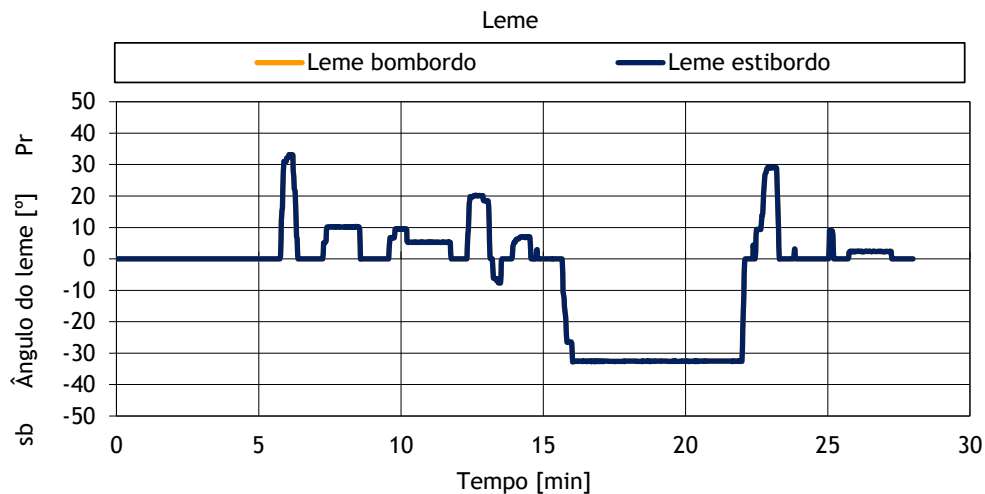
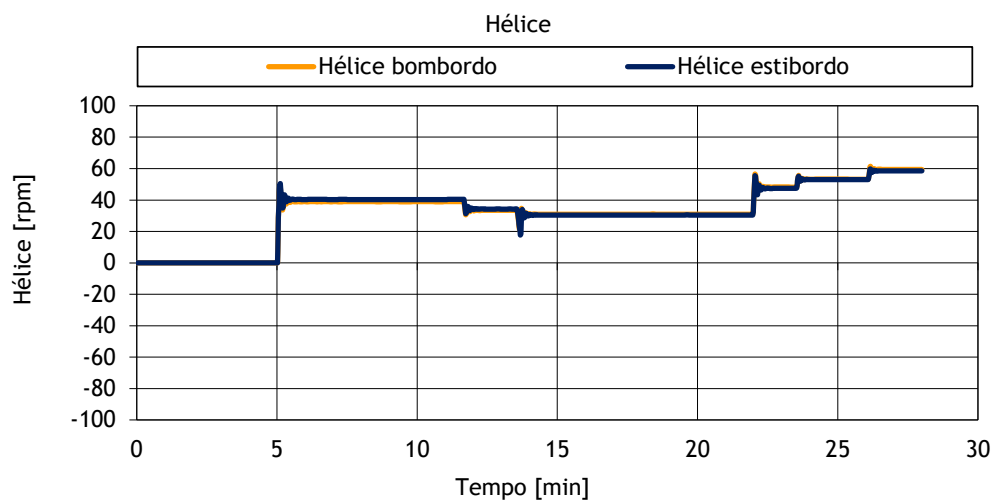
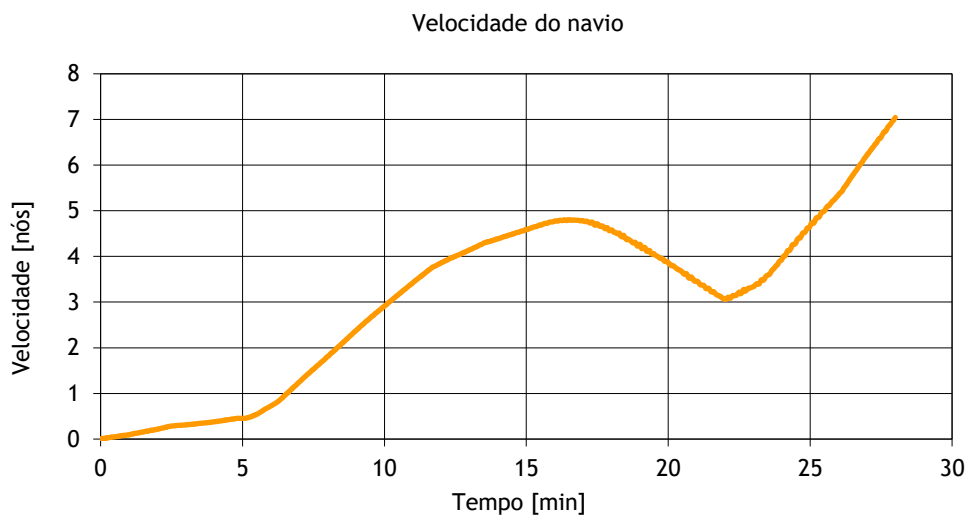
Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 3 500

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales



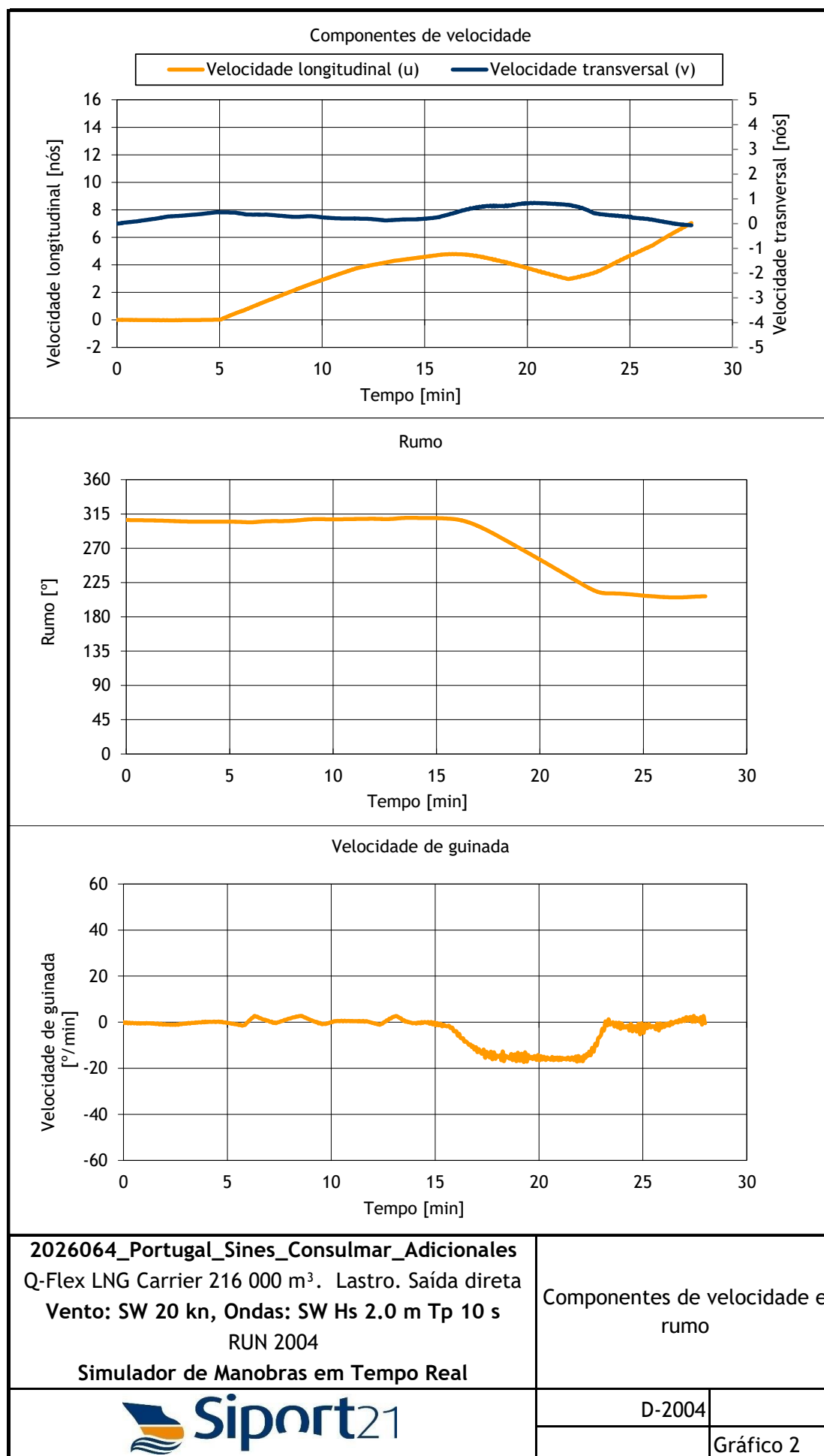
2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
 Vento: SW 20 kn, Ondas: SW Hs 2.0 m Tp 10 s
 RUN 2004
 Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

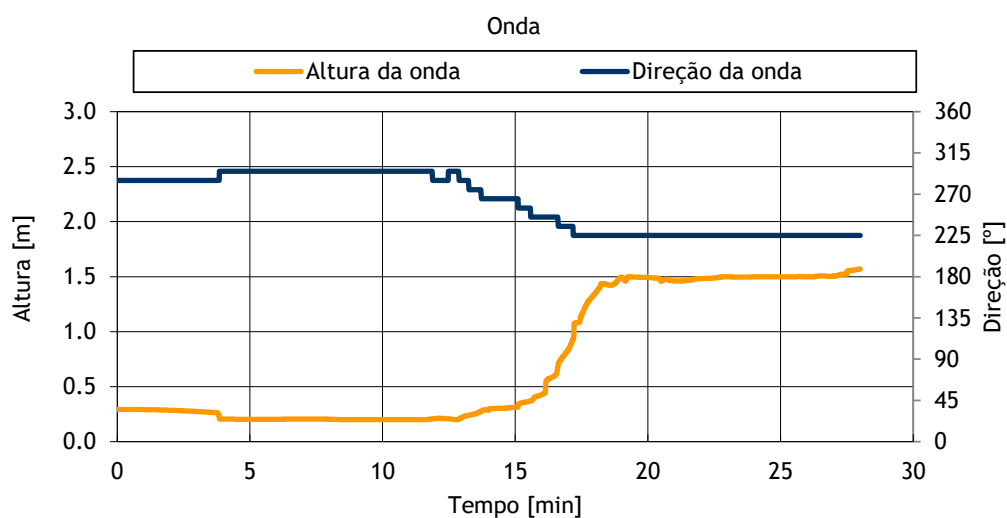
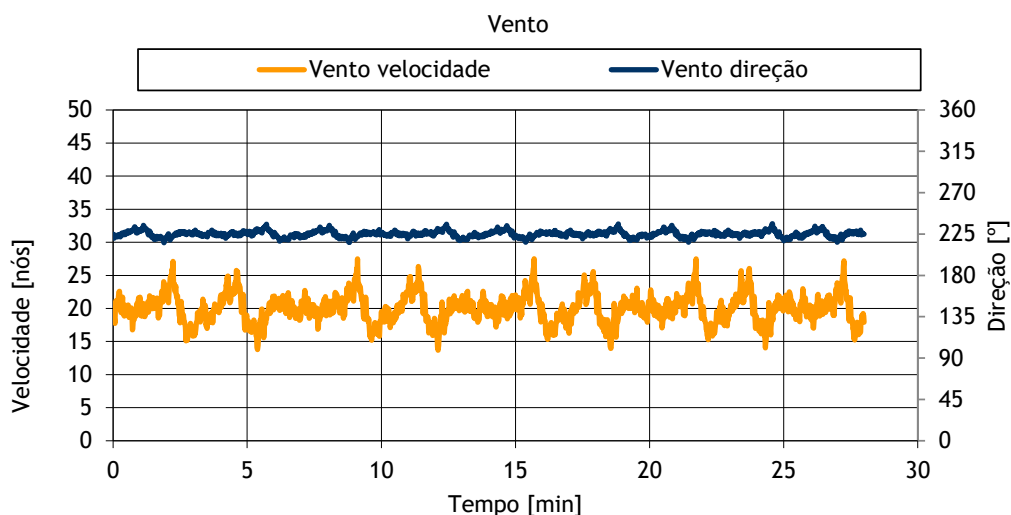
Velocidade, hélice e leme



D-2004

Gráfico 1





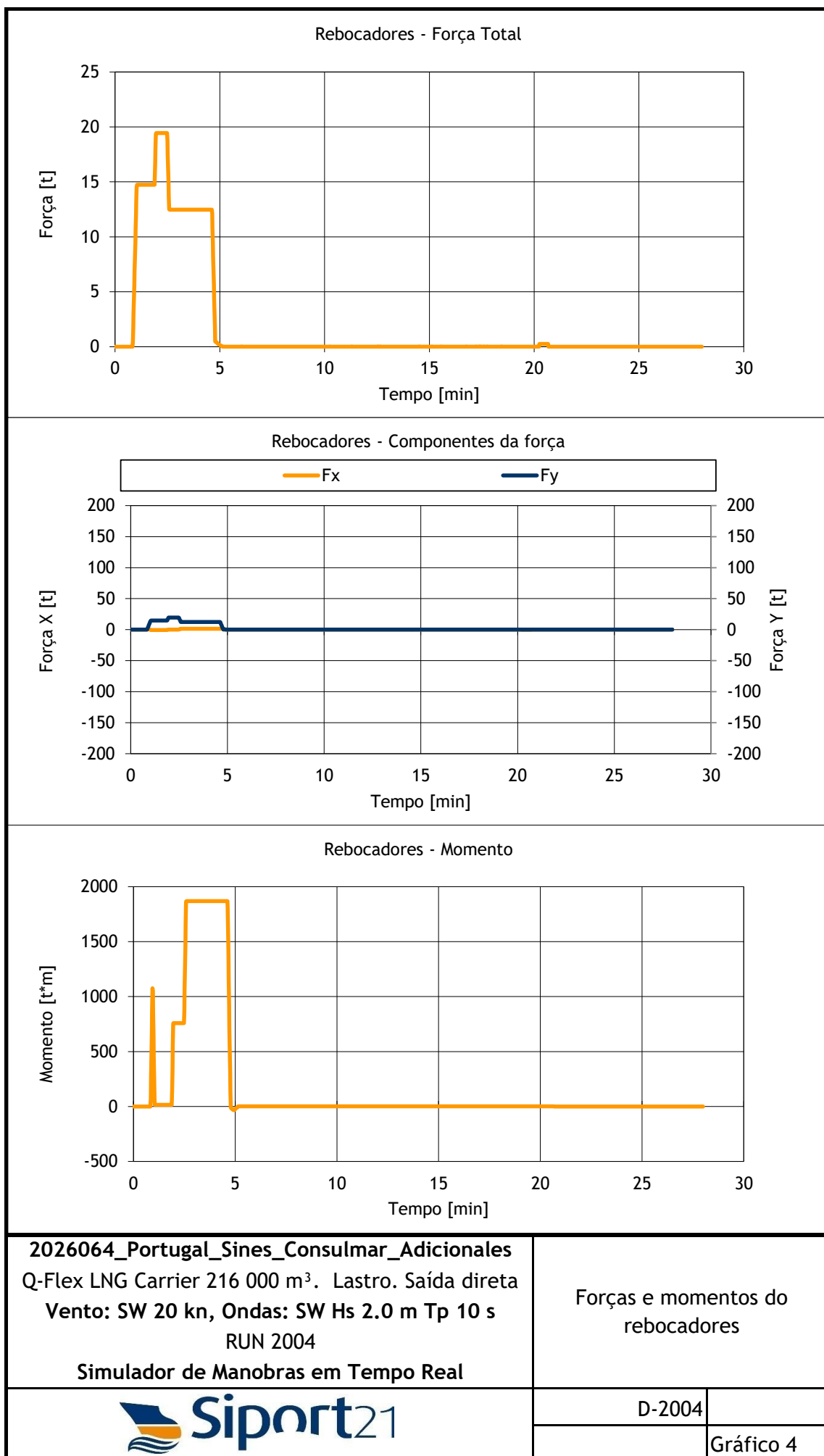
2026064_Portugal_Sines_Consulmar_Adicionales
Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
Vento: SW 20 kn, Ondas: SW Hs 2.0 m Tp 10 s
RUN 2004
Simulador de Manobras em Tempo Real

Condições climáticas

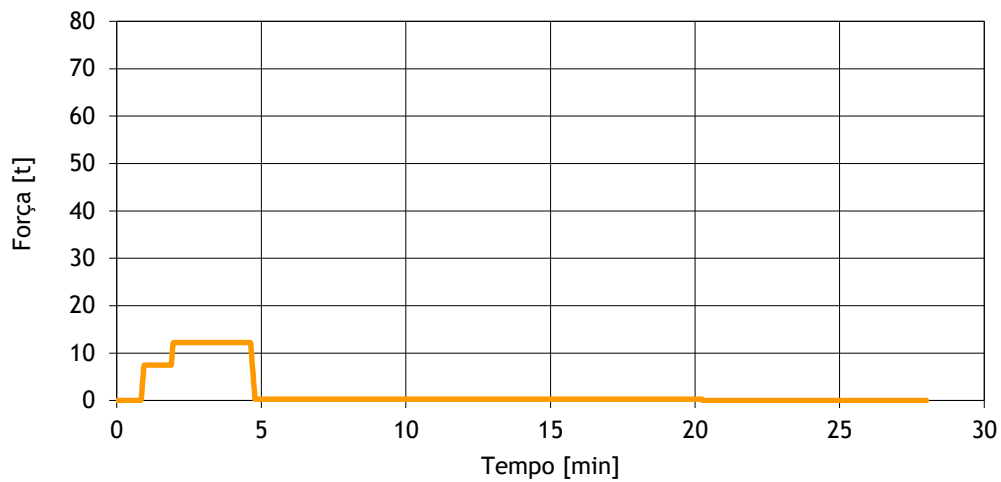


D-2004

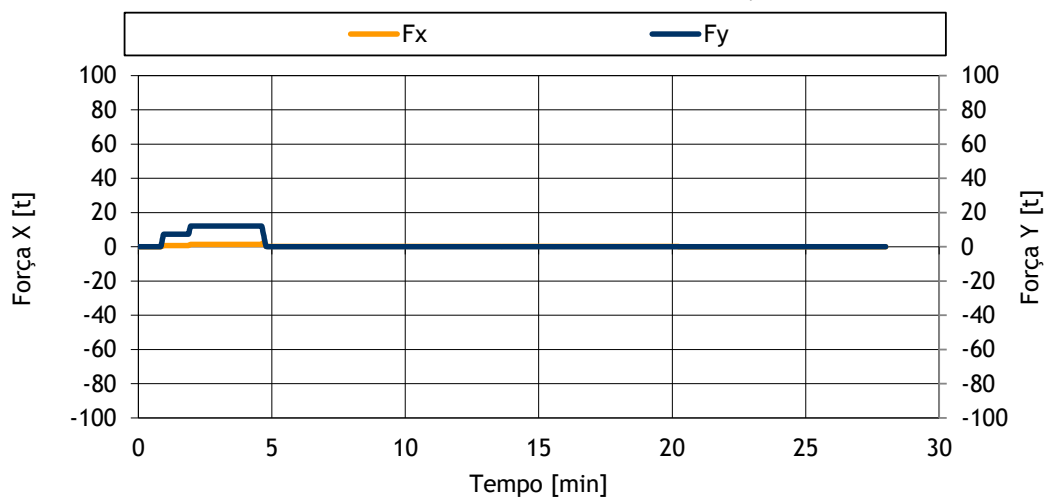
Gráfico 3



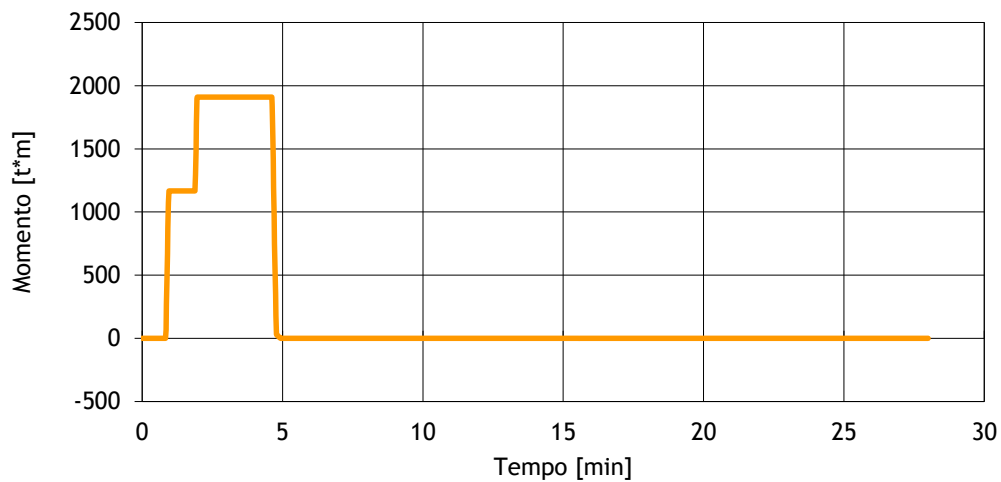
Rebocador 1 (25 t) - Força Total



Rebocador 1 (25 t) - Componentes da força



Rebocador 1 (25 t) - Momento



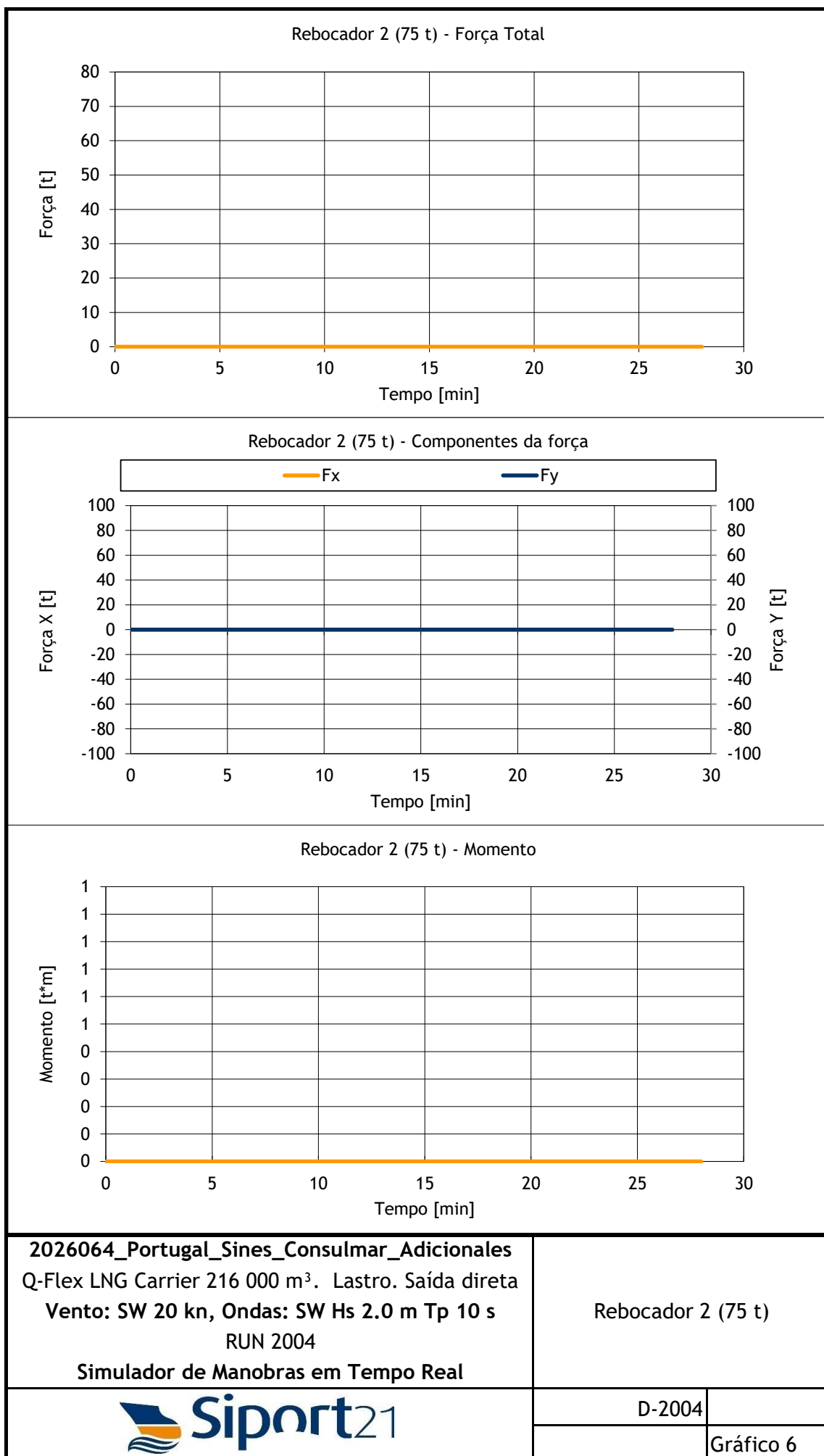
2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
 Vento: SW 20 kn, Ondas: SW Hs 2.0 m Tp 10 s
 RUN 2004
 Simulador de Manobras em Tempo Real

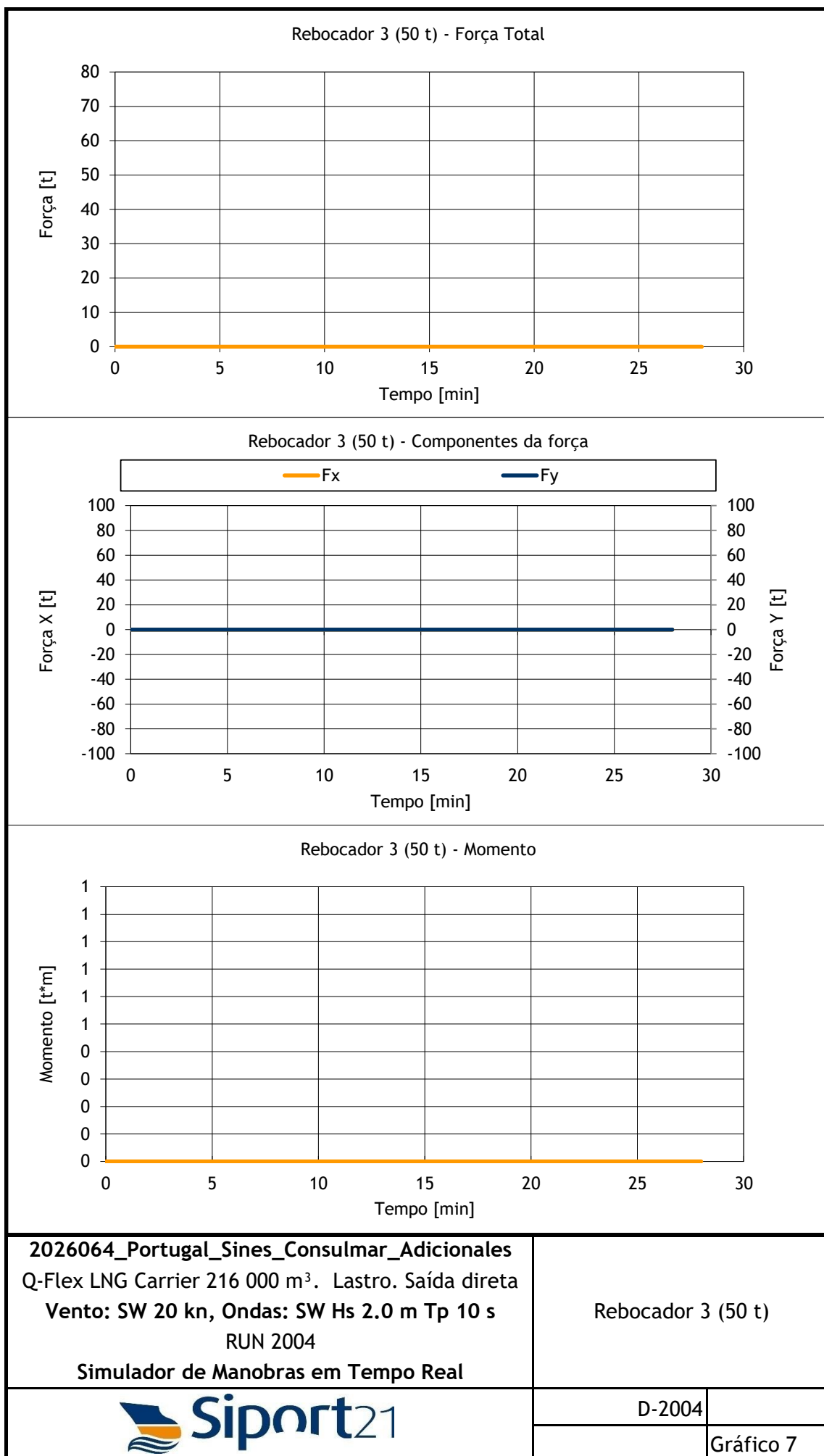
Rebocador 1 (25 t)



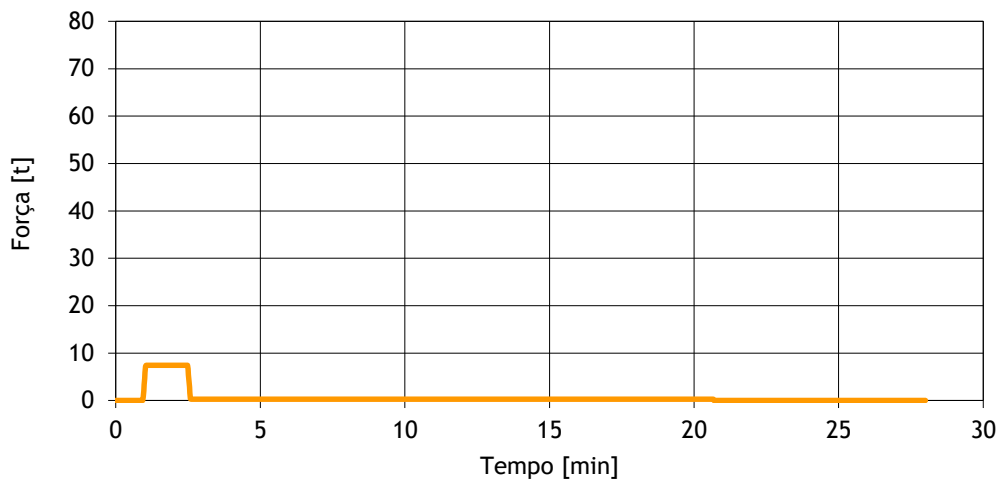
D-2004

Gráfico 5

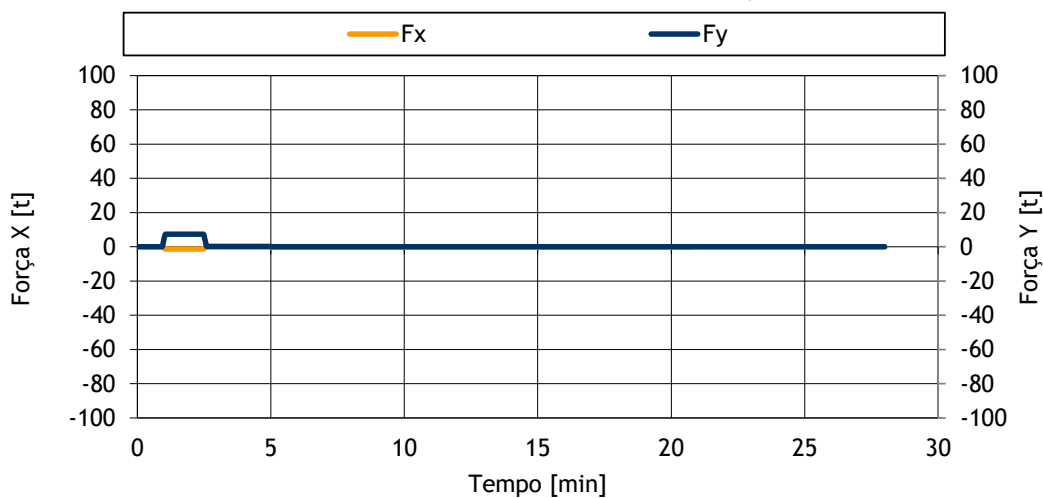




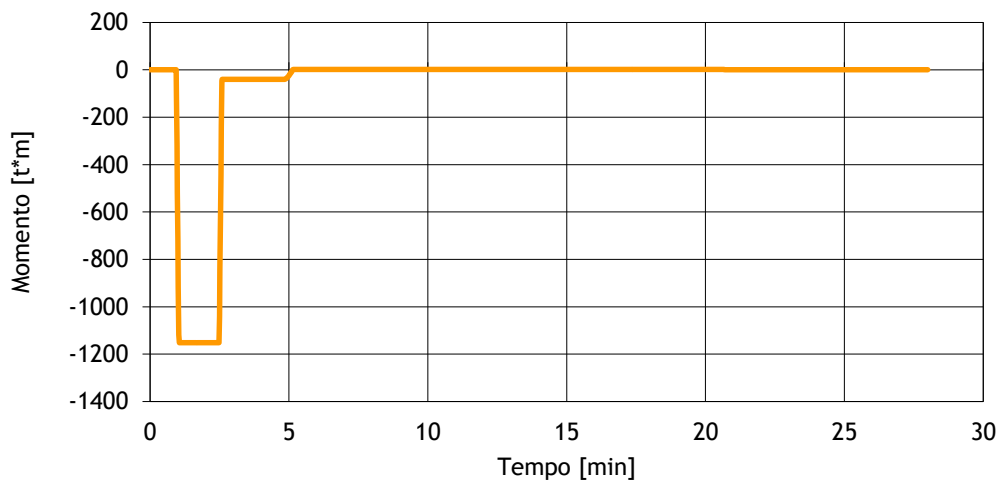
Rebocador 4 (25 t) - Força Total



Rebocador 4 (25 t) - Componentes da força



Rebocador 4 (25 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: SW 20 kn, Ondas: SW Hs 2.0 m Tp 10 s

RUN 2004

Simulador de Manobras em Tempo Real

Rebocador 4 (25 t)



D-2004

Gráfico 8

RUN 2005

**Q-Flex LNG Carrier 216 000 m³. Lastro. Saída
direta**

Vento: SW 25 kn, Ondas: SW Hs 2.0 m Tp 10 s

Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

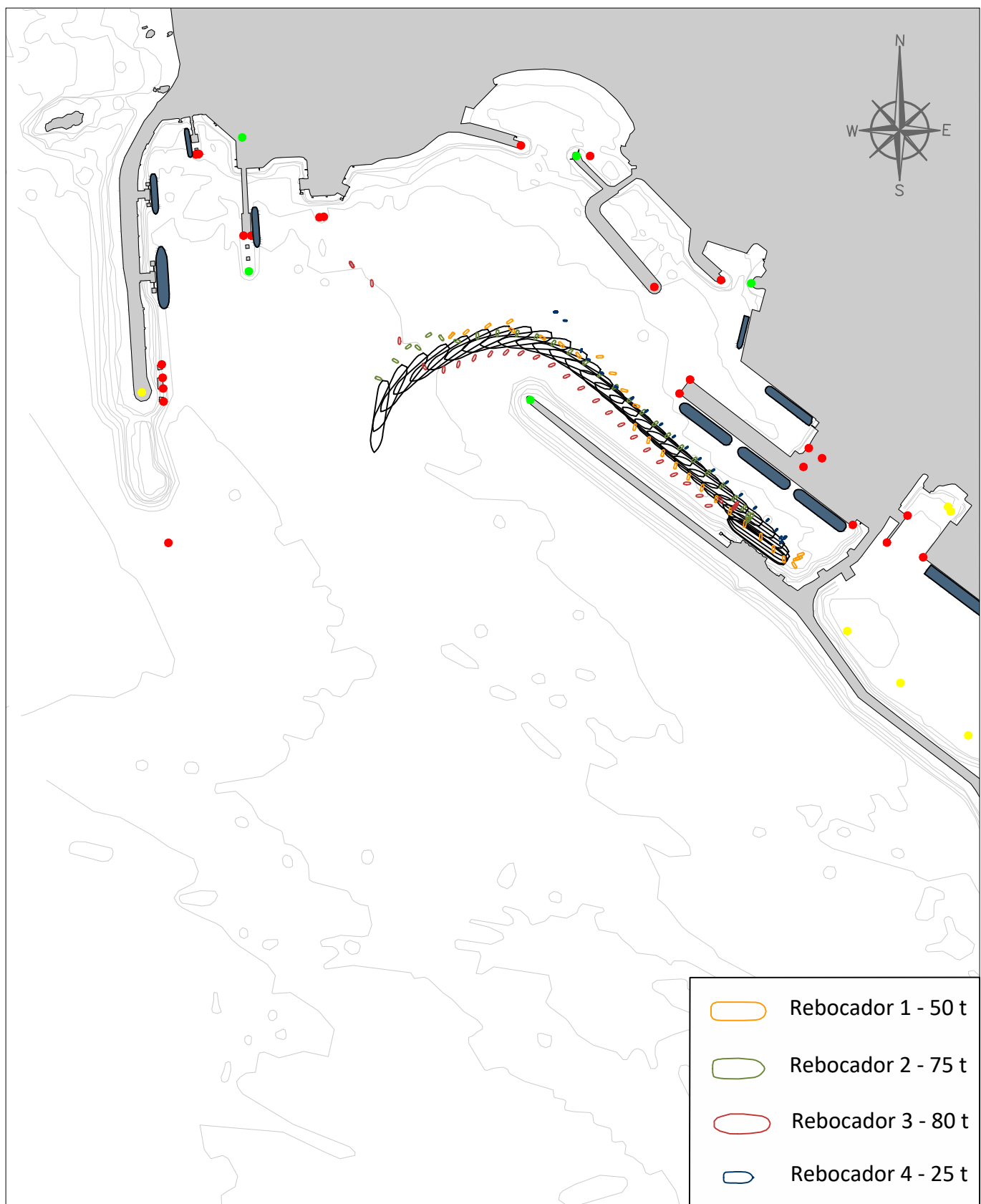


Figure: Trk-2005

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: SW 25 kn, Ondas: SW Hs 2.0 m Tp 10 s

Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 6 000

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales

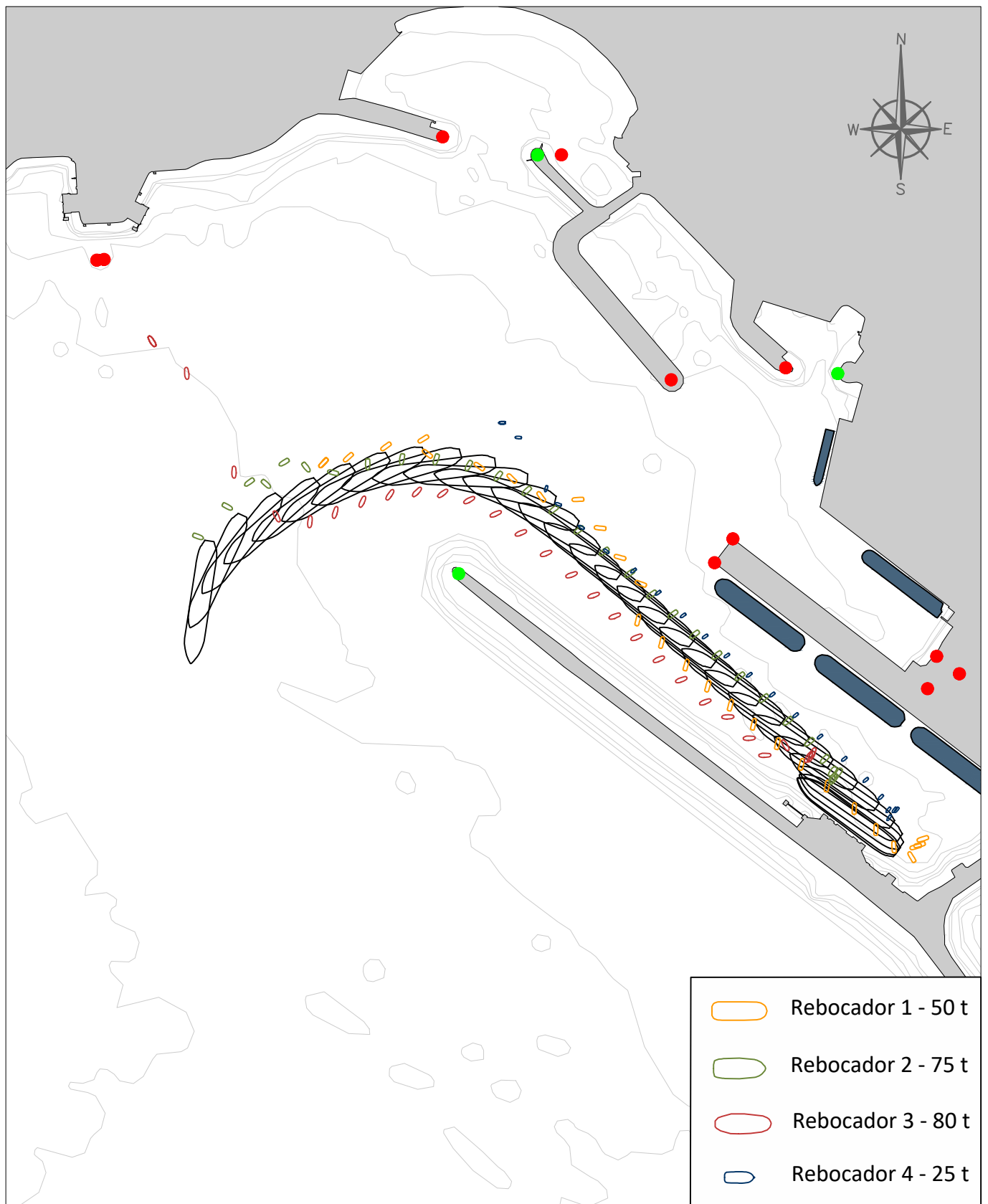


Figure: Trk-2005

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: SW 25 kn, Ondas: SW Hs 2.0 m Tp 10 s

Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

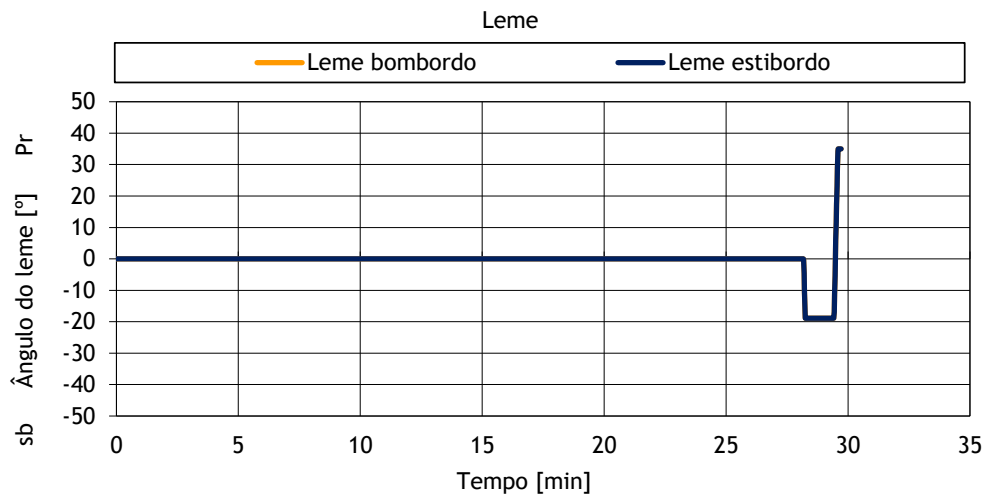
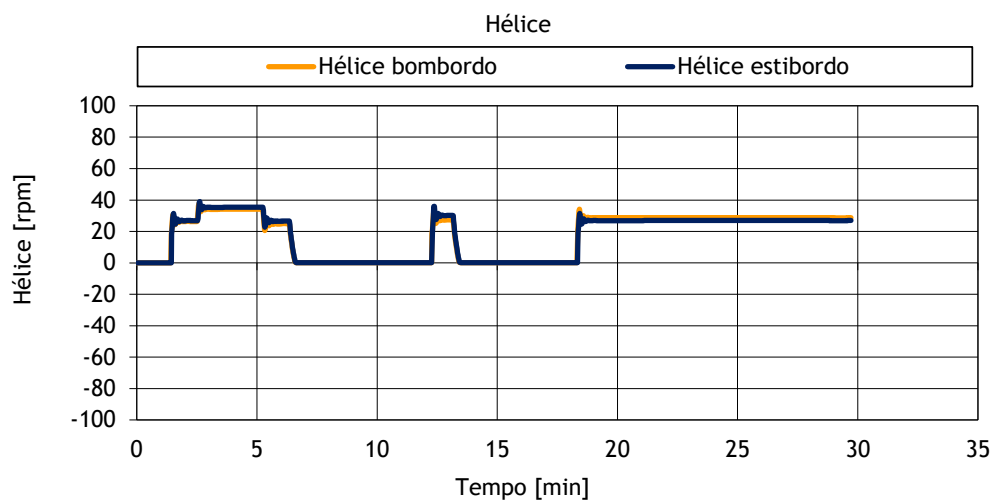
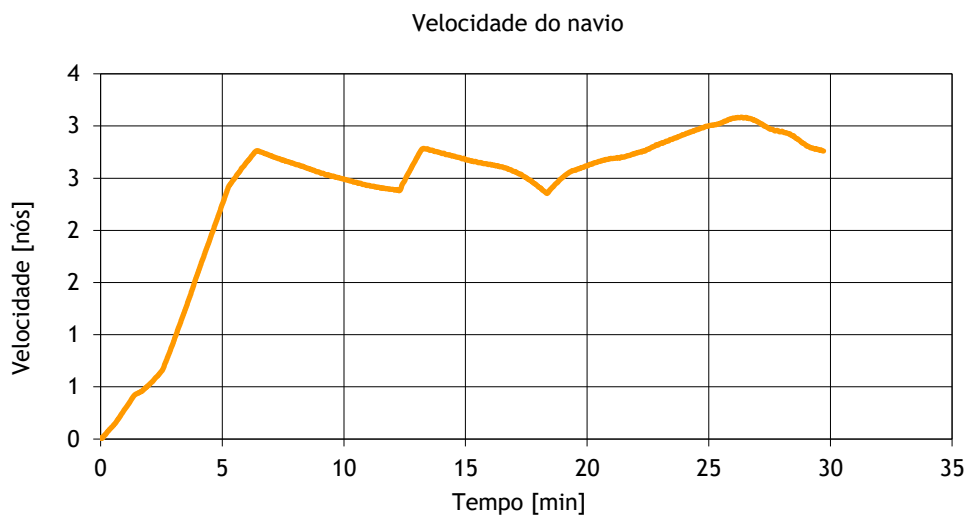
Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 3 500

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales





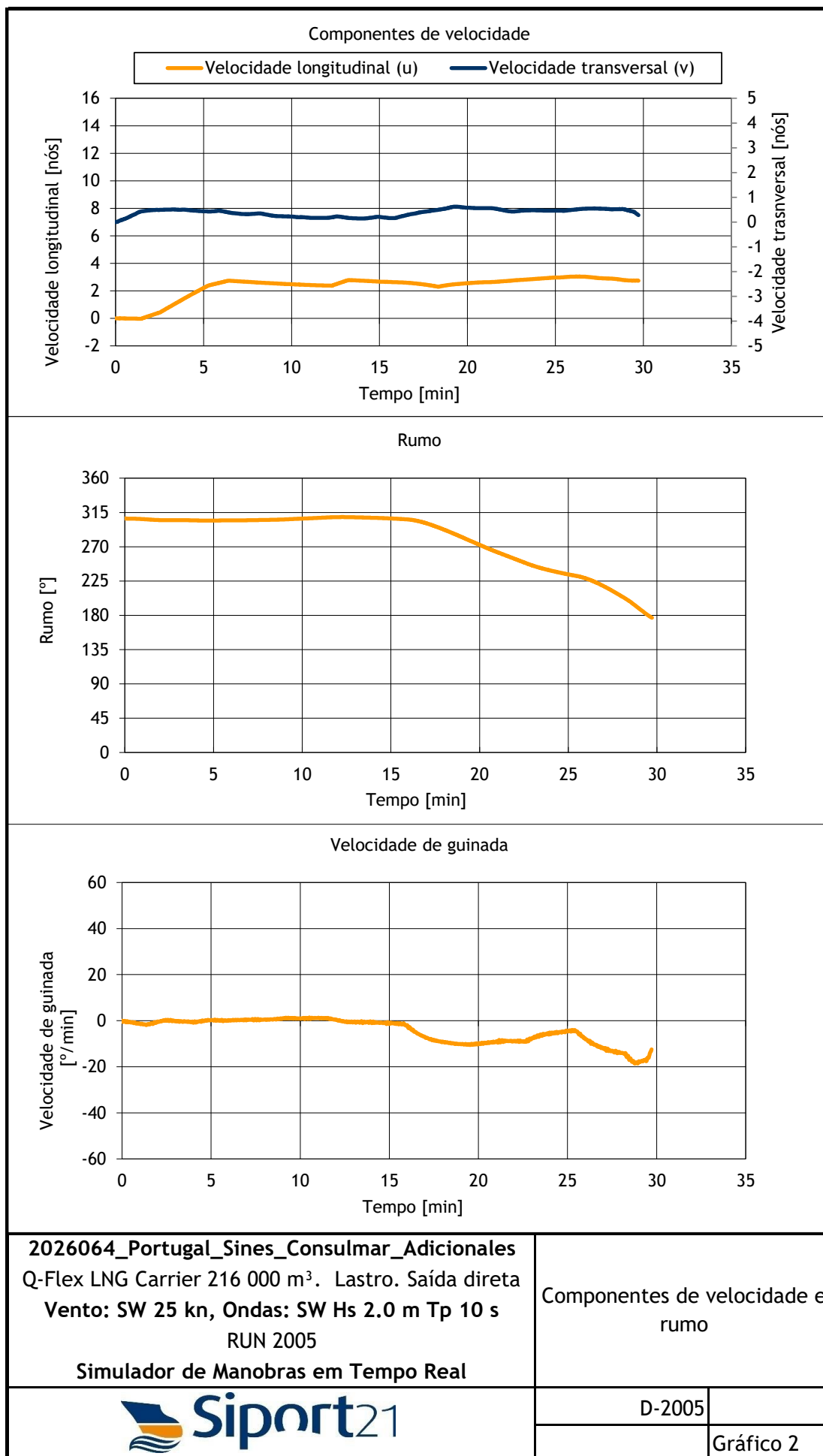
2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
 Vento: SW 25 kn, Ondas: SW Hs 2.0 m Tp 10 s
 RUN 2005
 Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

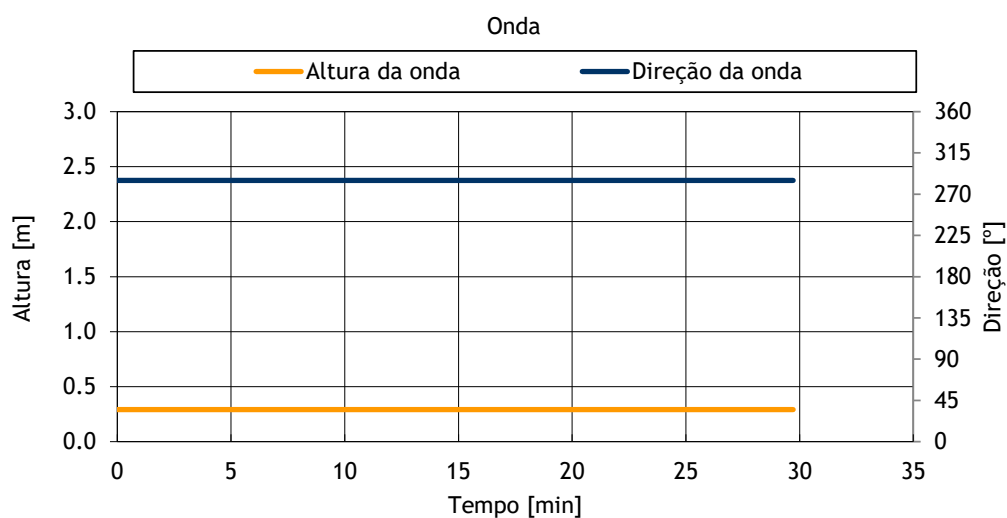
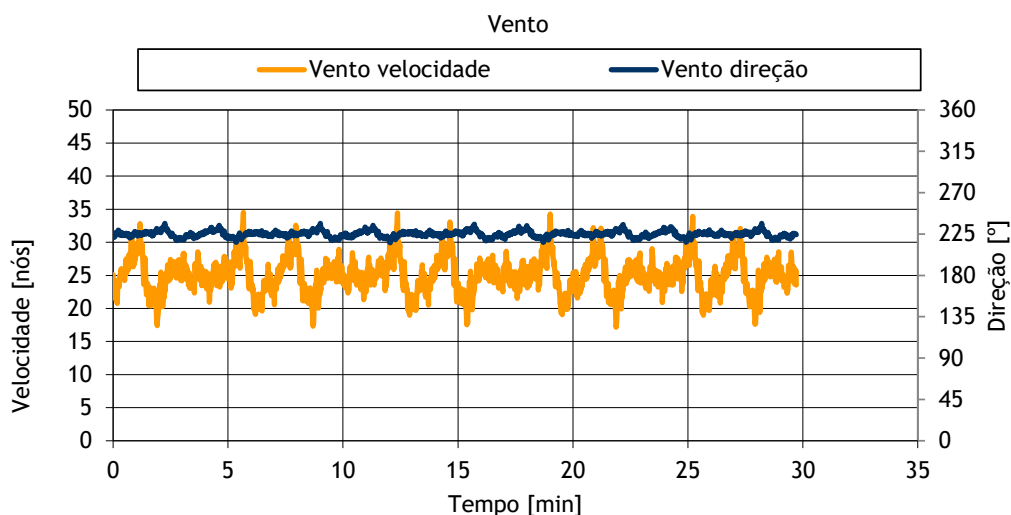
Velocidade, hélice e leme



D-2005

Gráfico 1





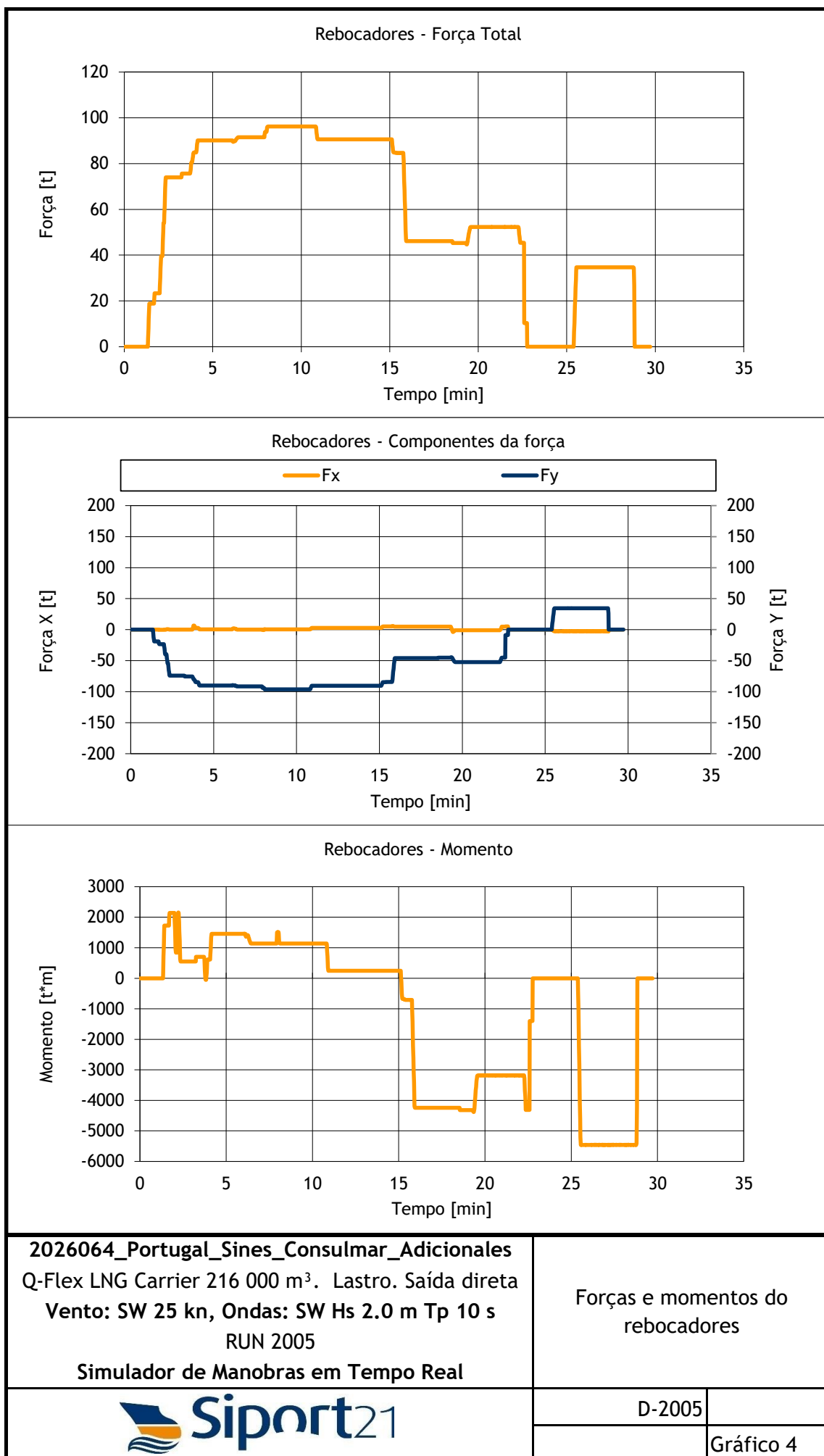
2026064_Portugal_Sines_Consulmar_Adicionales
Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
Vento: SW 25 kn, Ondas: SW Hs 2.0 m Tp 10 s
RUN 2005
Simulador de Manobras em Tempo Real

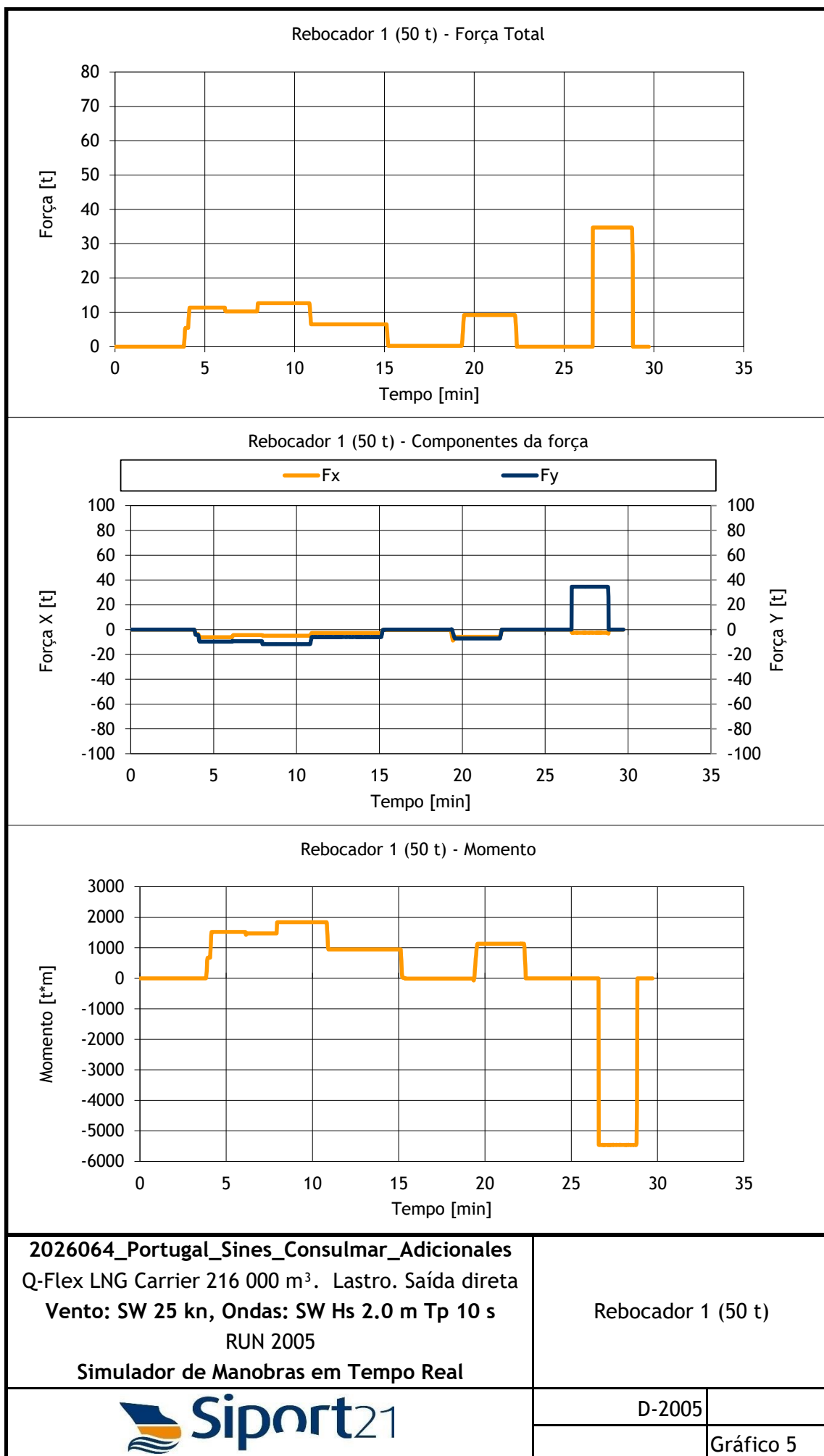
Condições climáticas



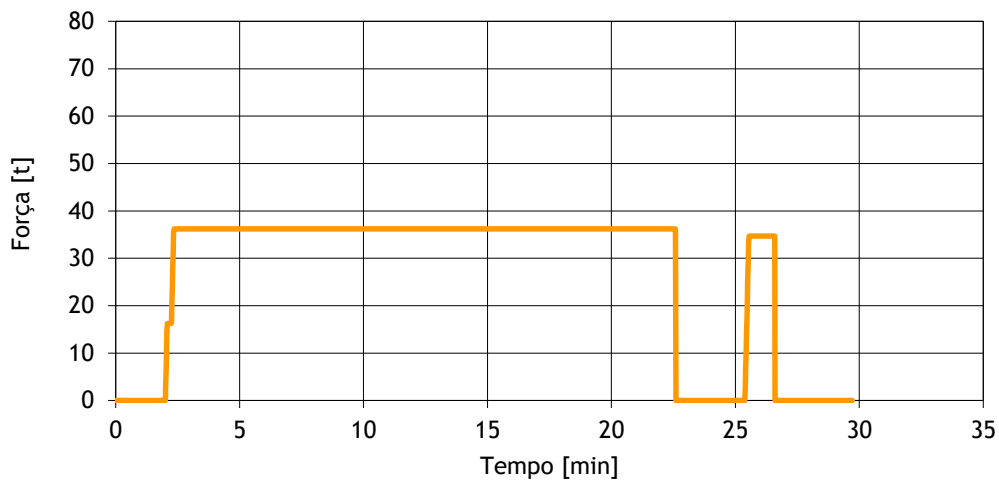
D-2005

Gráfico 3

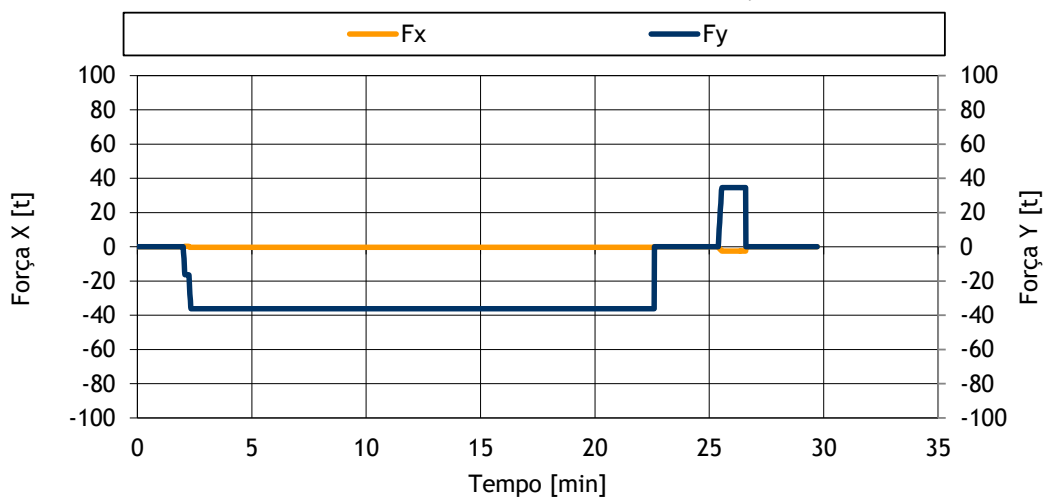




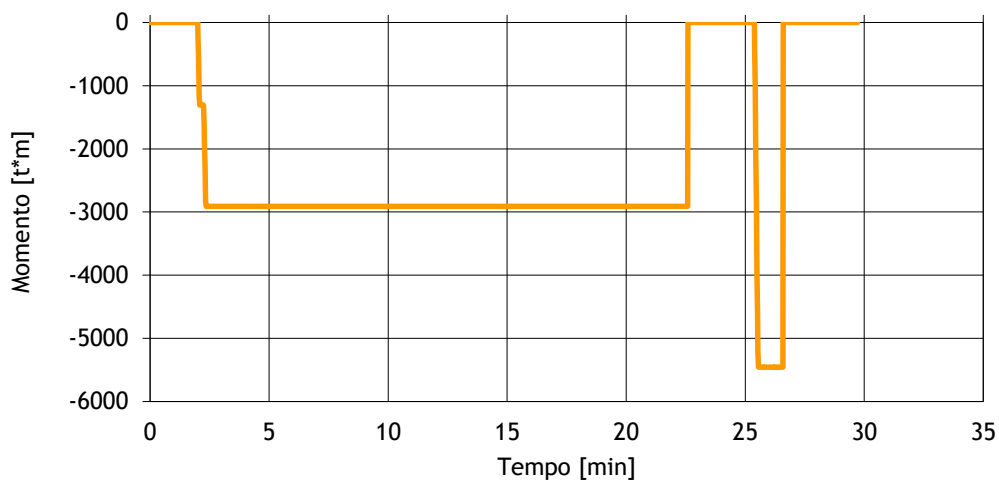
Rebocador 2 (75 t) - Força Total



Rebocador 2 (75 t) - Componentes da força



Rebocador 2 (75 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: SW 25 kn, Ondas: SW Hs 2.0 m Tp 10 s

RUN 2005

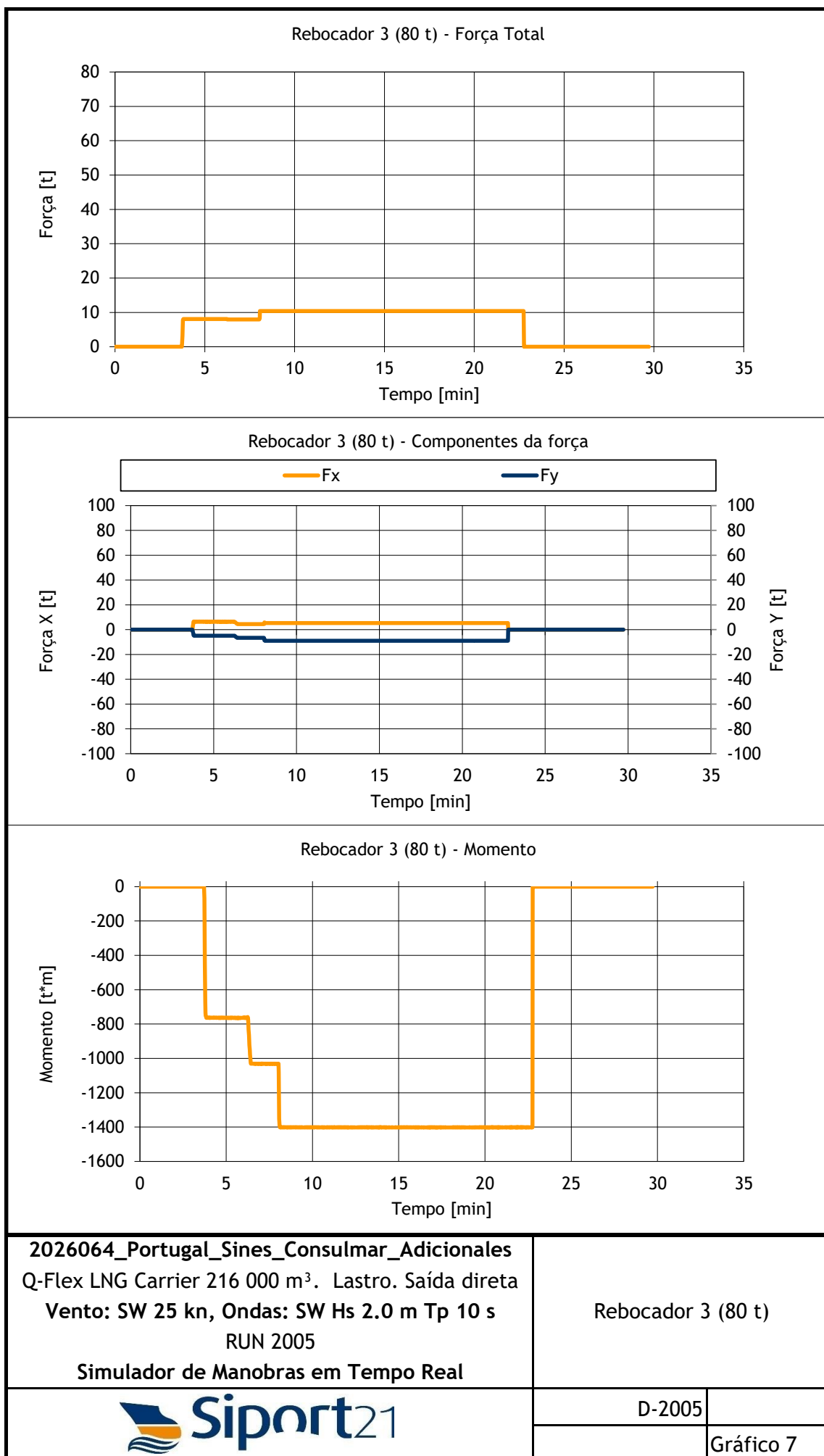
Simulador de Manobras em Tempo Real

Rebocador 2 (75 t)

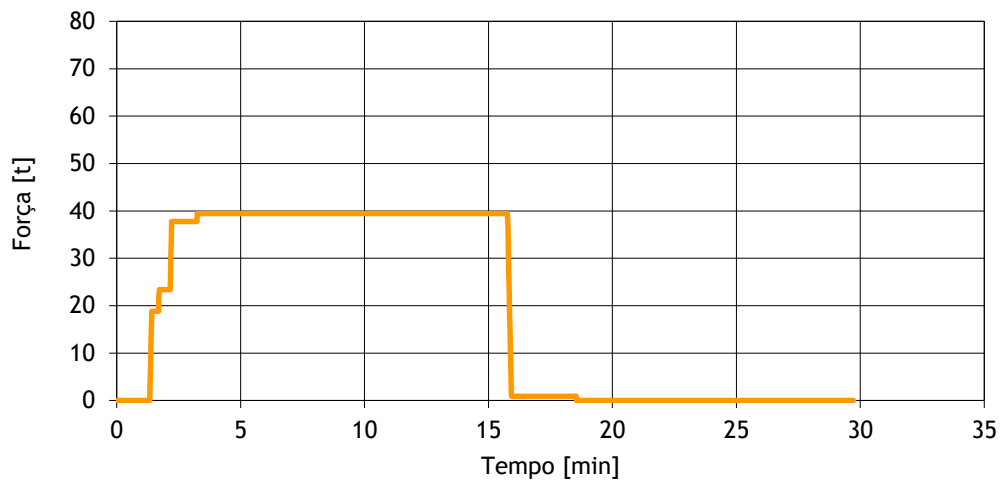


D-2005

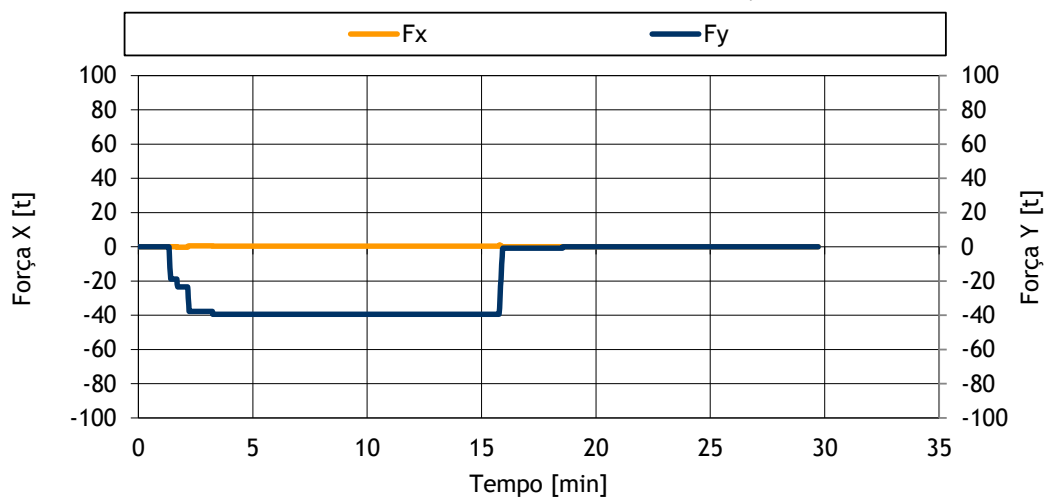
Gráfico 6



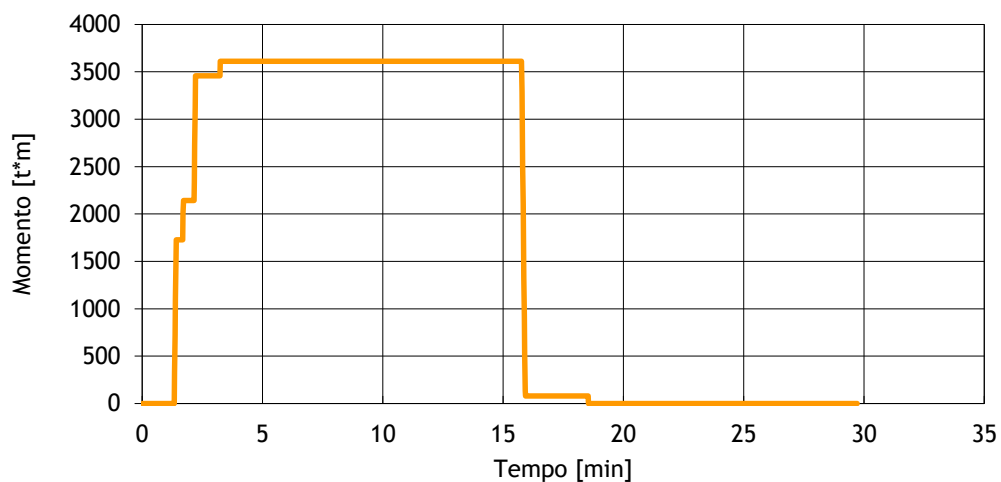
Rebocador 4 (25 t) - Força Total



Rebocador 4 (25 t) - Componentes da força



Rebocador 4 (25 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: SW 25 kn, Ondas: SW Hs 2.0 m Tp 10 s

RUN 2005

Simulador de Manobras em Tempo Real

Rebocador 4 (25 t)



D-2005

Gráfico 8

RUN 2006

**Q-Flex LNG Carrier 216 000 m³. Lastro. Saída
direta**

Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

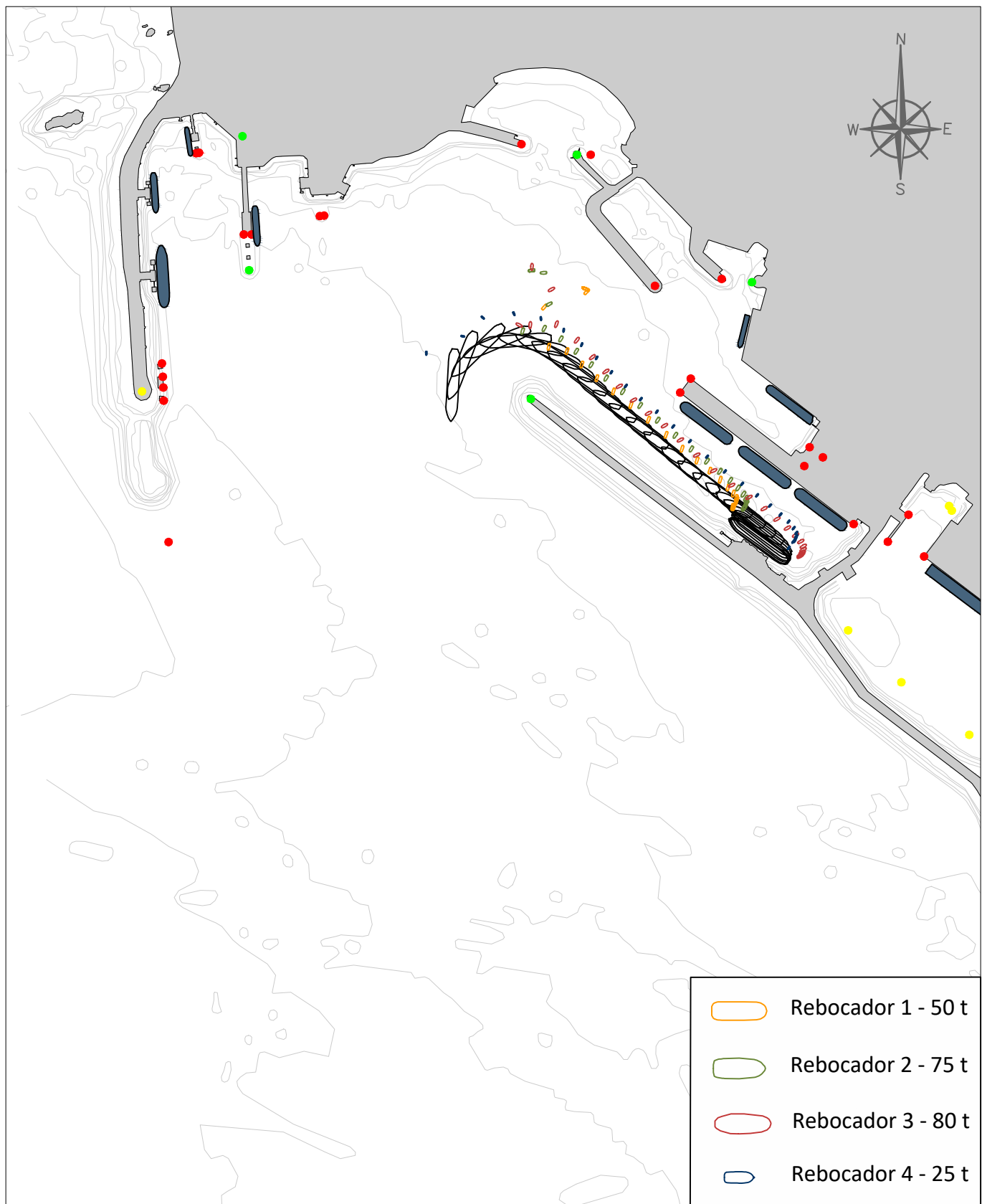


Figure: Trk-2006

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 6 000

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales

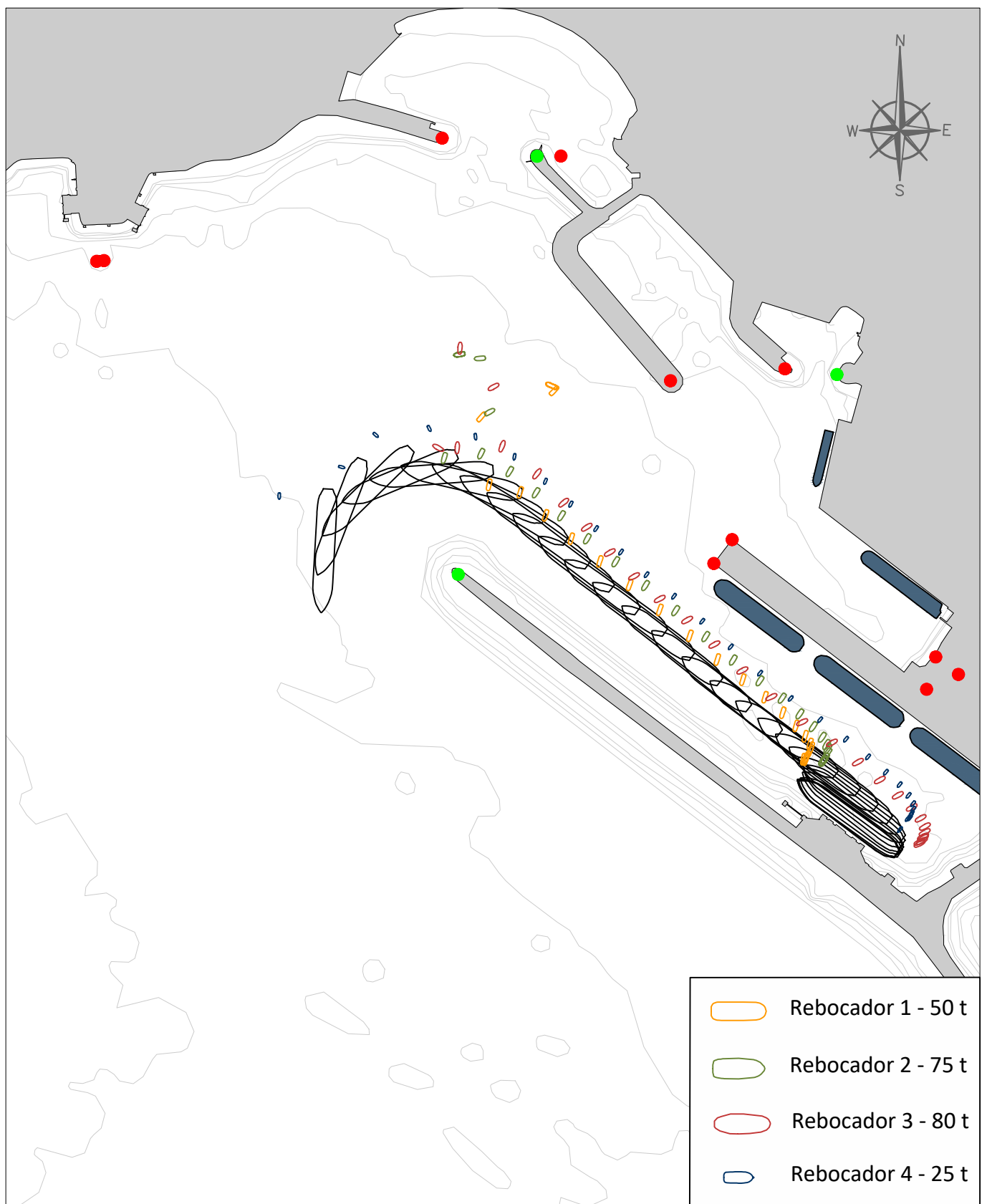


Figure: Trk-2006

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

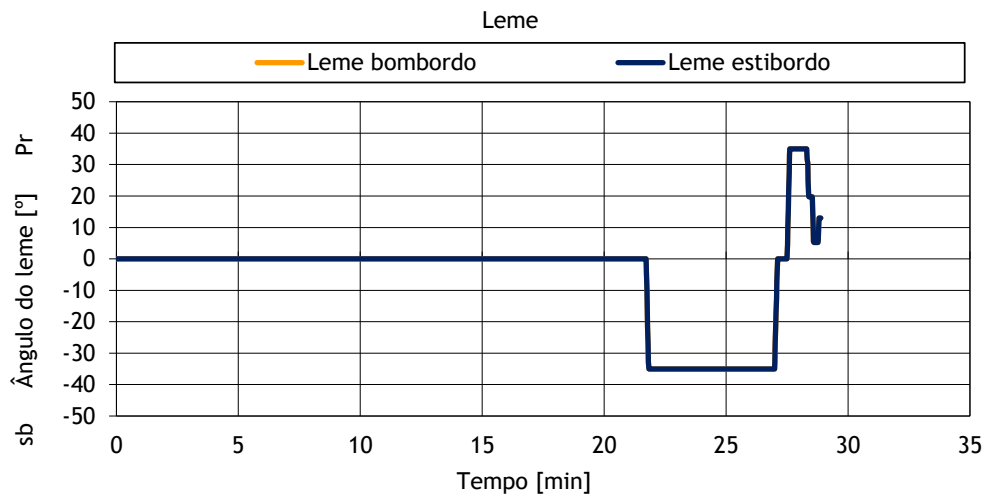
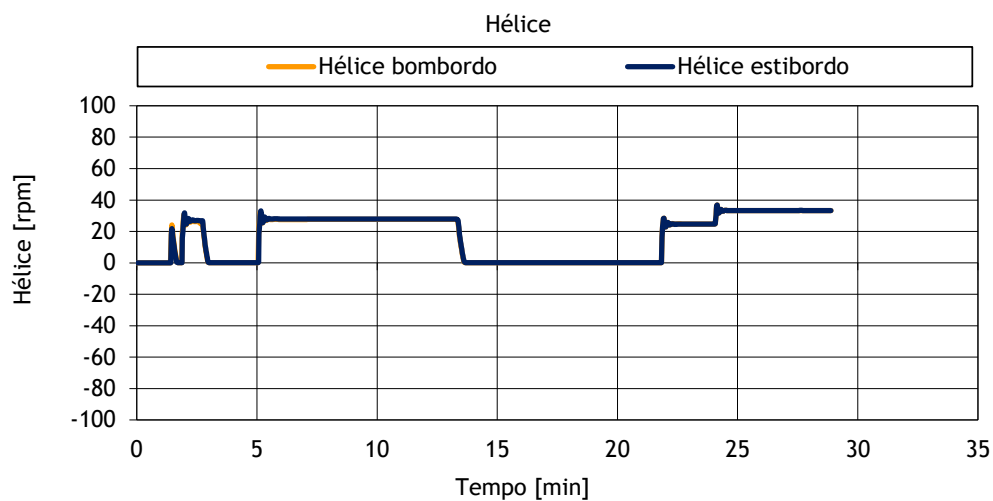
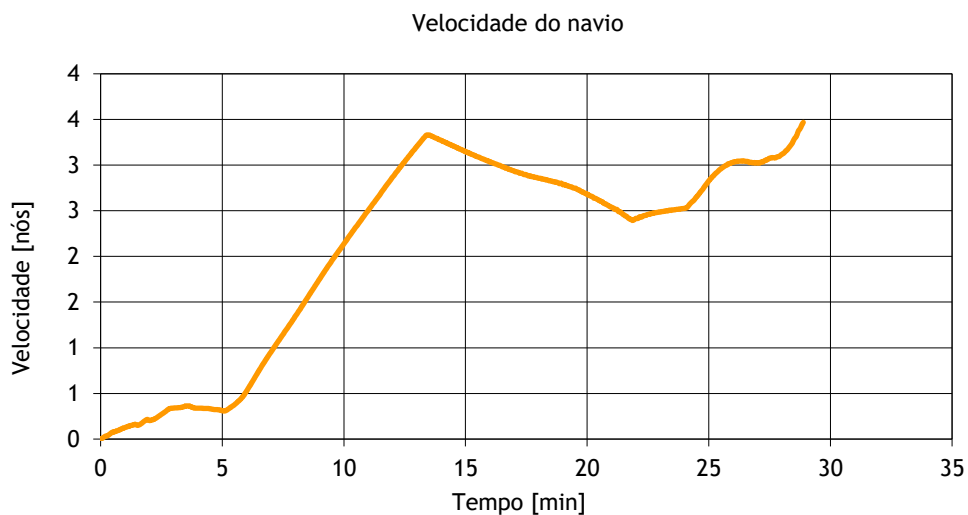
Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 3 500

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales



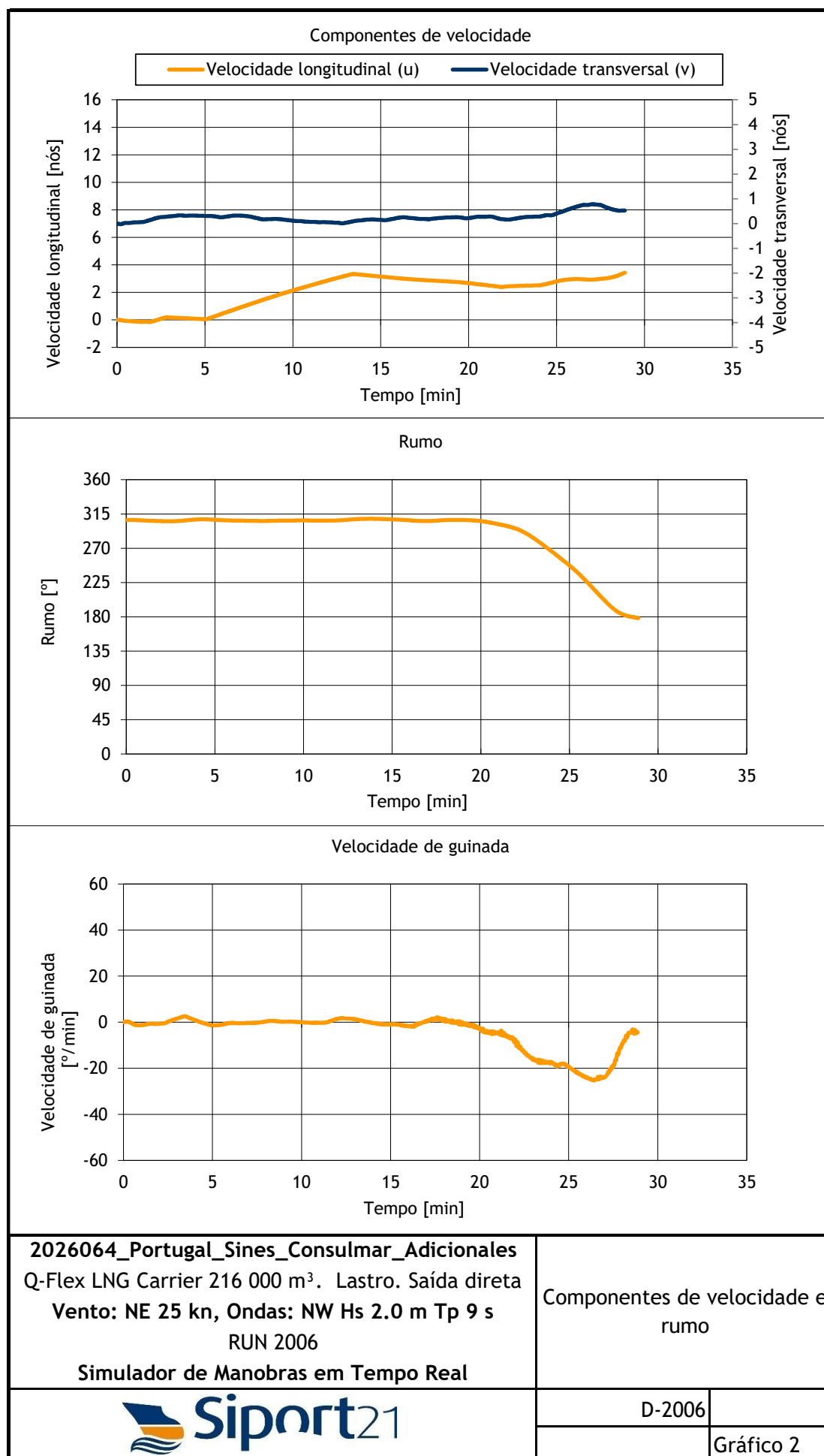
2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s
 RUN 2006
Rebocadores: 4 (50 t + 75 t + 80 t + 25 t)

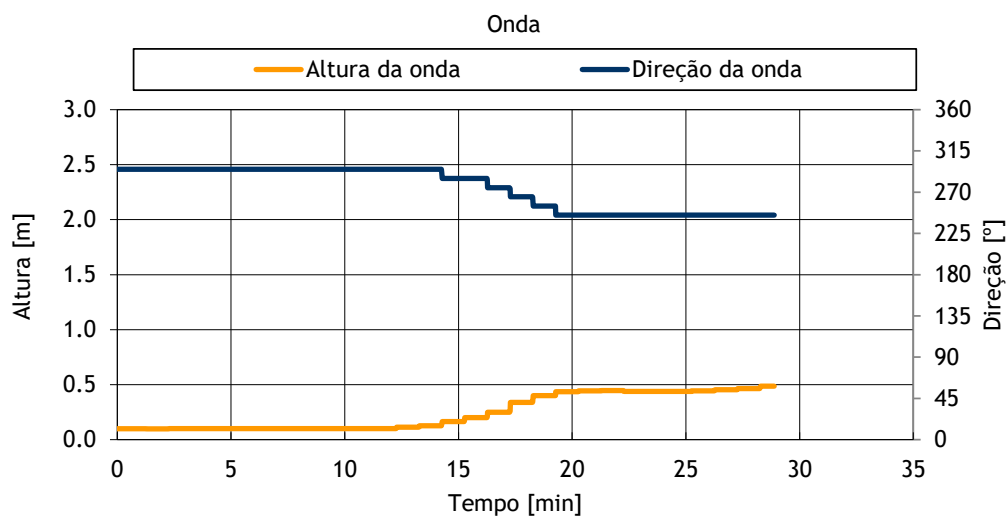
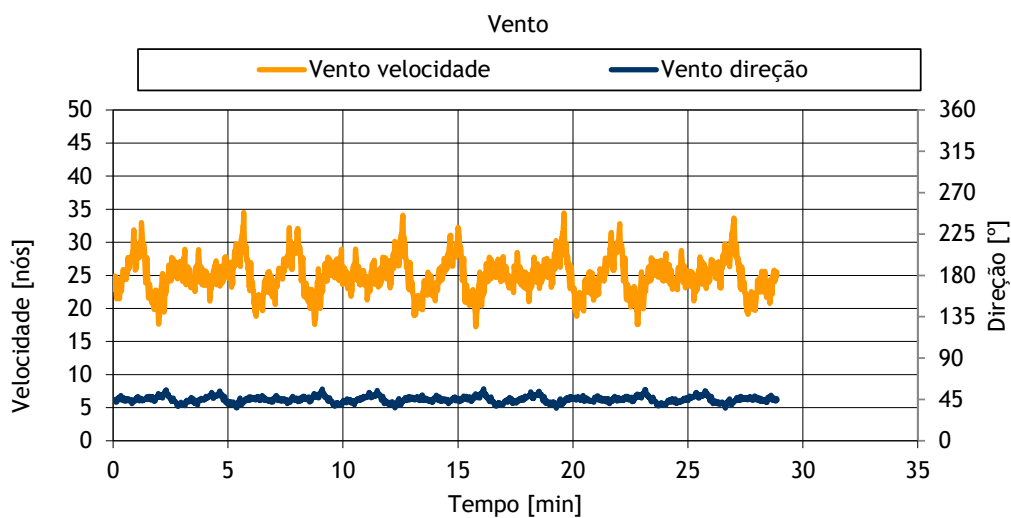
Velocidade, hélice e leme



D-2006

Gráfico 1





2026064_Portugal_Sines_Consulmar_Adicionales
Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 2006

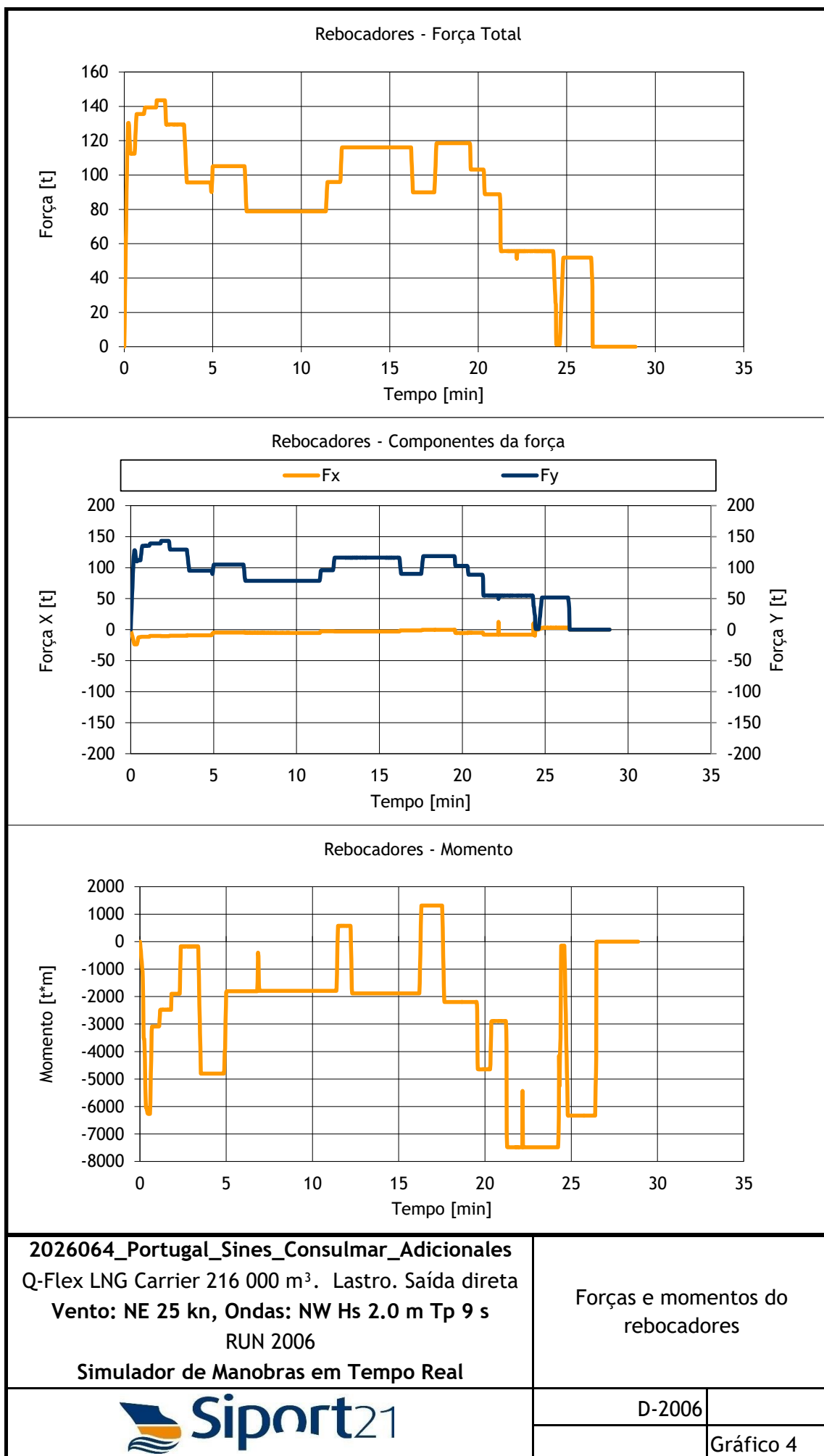
Simulador de Manobras em Tempo Real

Condições climáticas

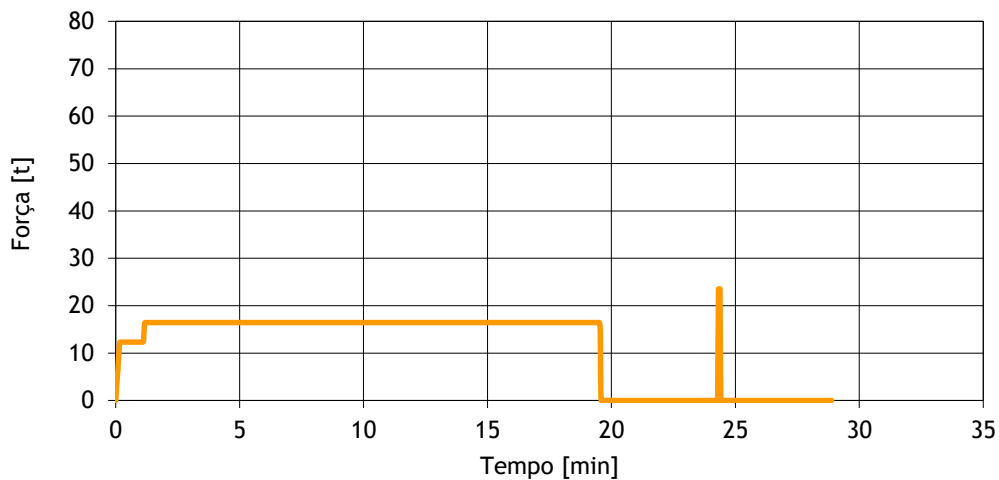


D-2006

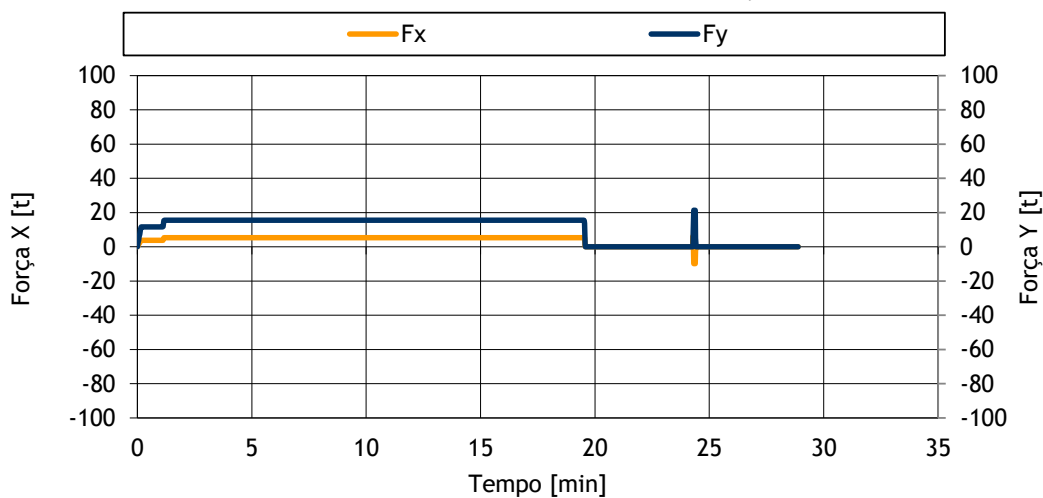
Gráfico 3



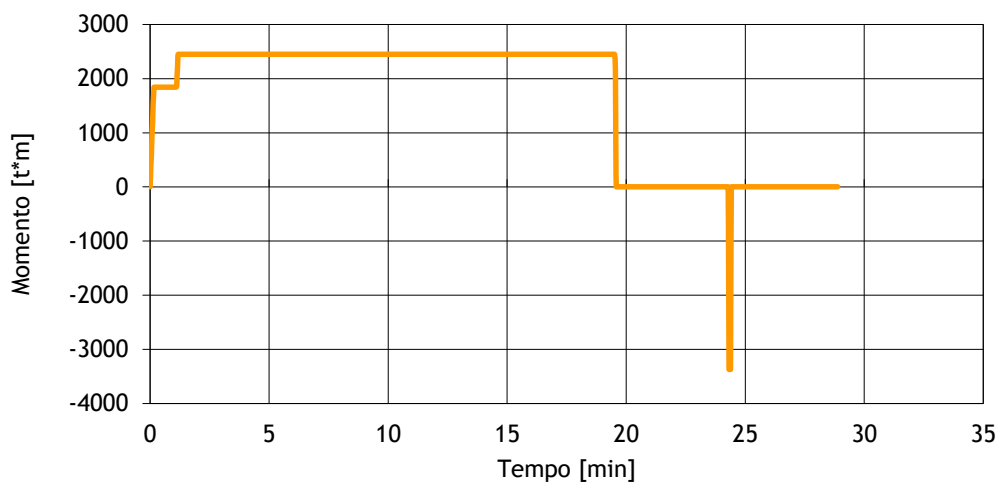
Rebocador 1 (50 t) - Força Total



Rebocador 1 (50 t) - Componentes da força



Rebocador 1 (50 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 2006

Simulador de Manobras em Tempo Real

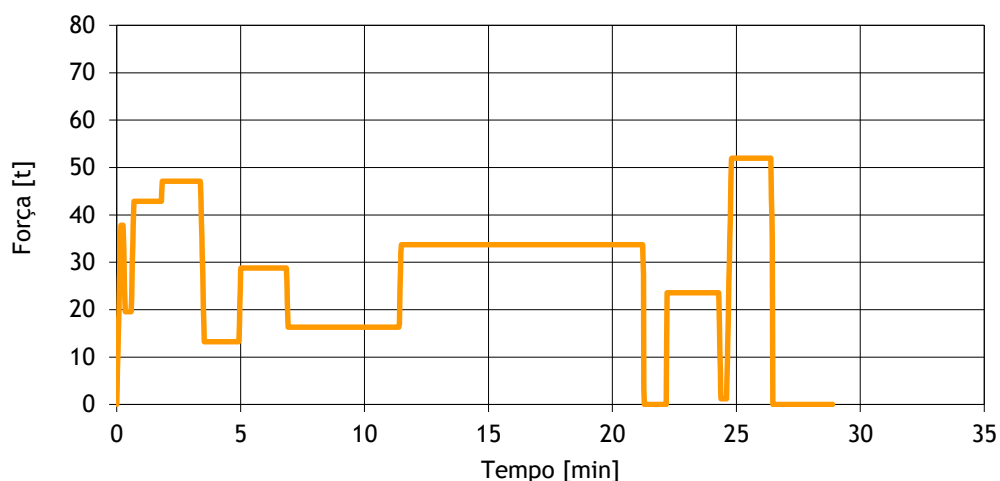
Rebocador 1 (50 t)



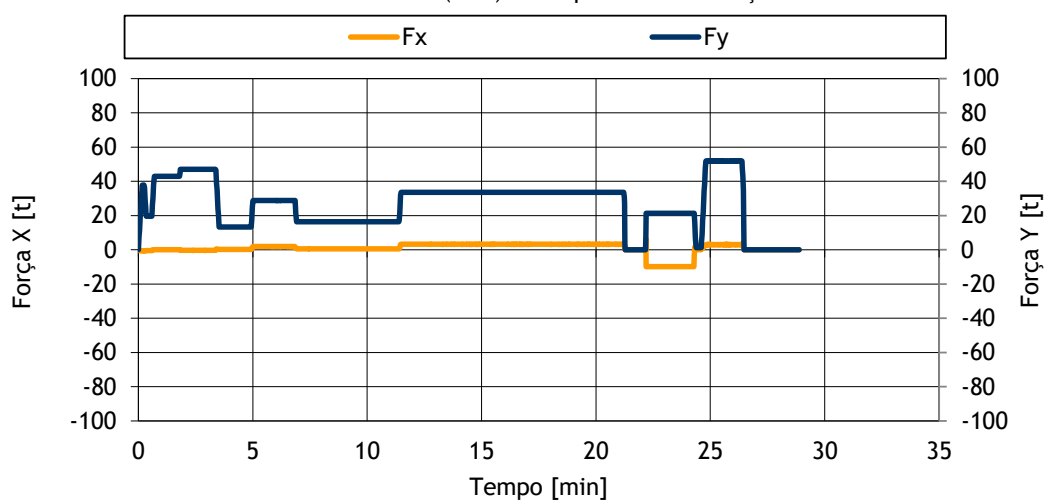
D-2006

Gráfico 5

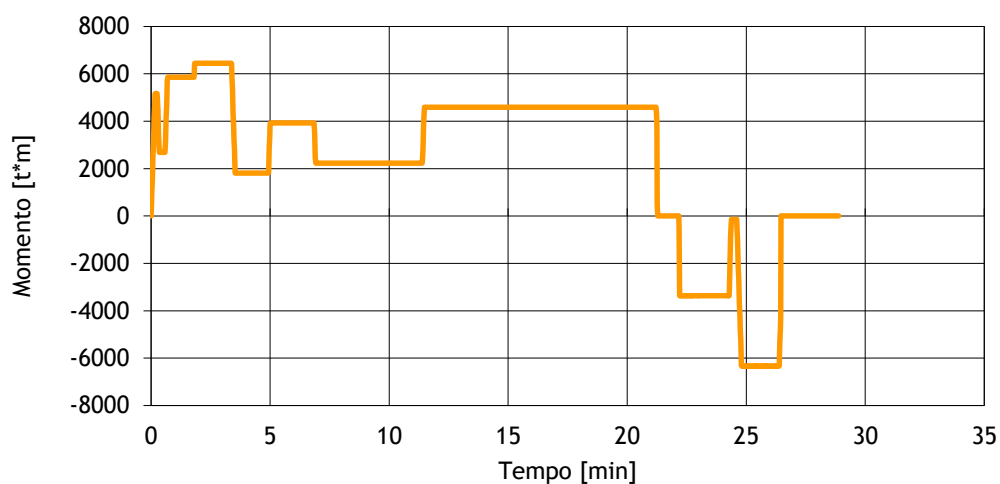
Rebocador 2 (75 t) - Força Total



Rebocador 2 (75 t) - Componentes da força



Rebocador 2 (75 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
 Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s
 RUN 2006
 Simulador de Manobras em Tempo Real

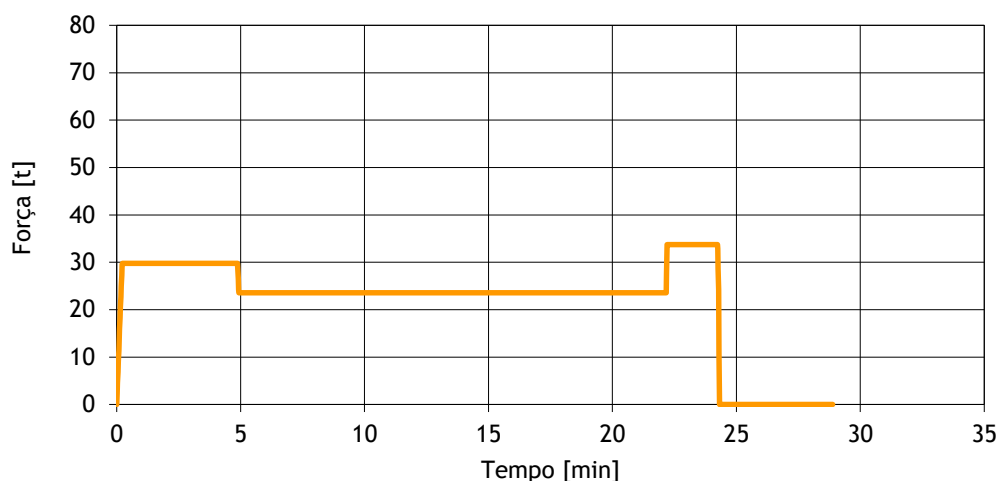
Rebocador 2 (75 t)



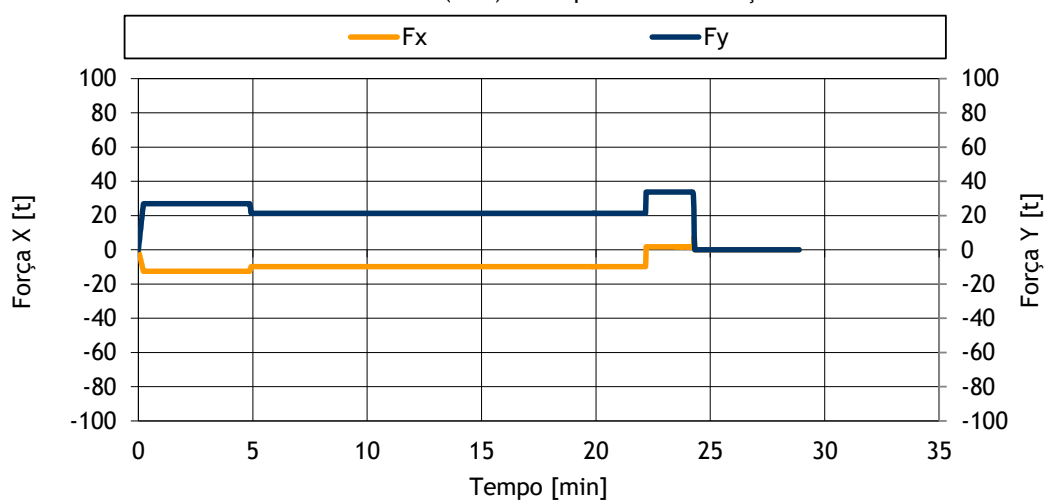
D-2006

Gráfico 6

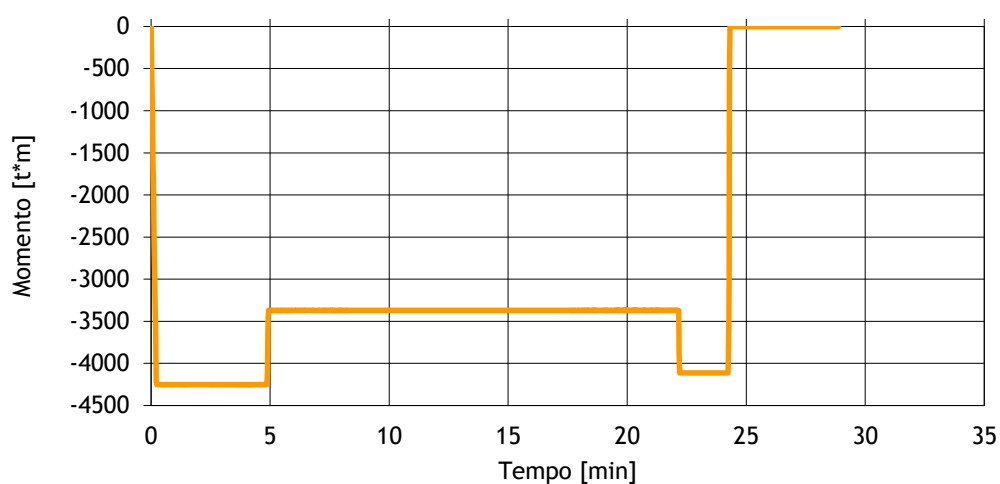
Rebocador 3 (80 t) - Força Total



Rebocador 3 (80 t) - Componentes da força



Rebocador 3 (80 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
 Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s
 RUN 2006
 Simulador de Manobras em Tempo Real

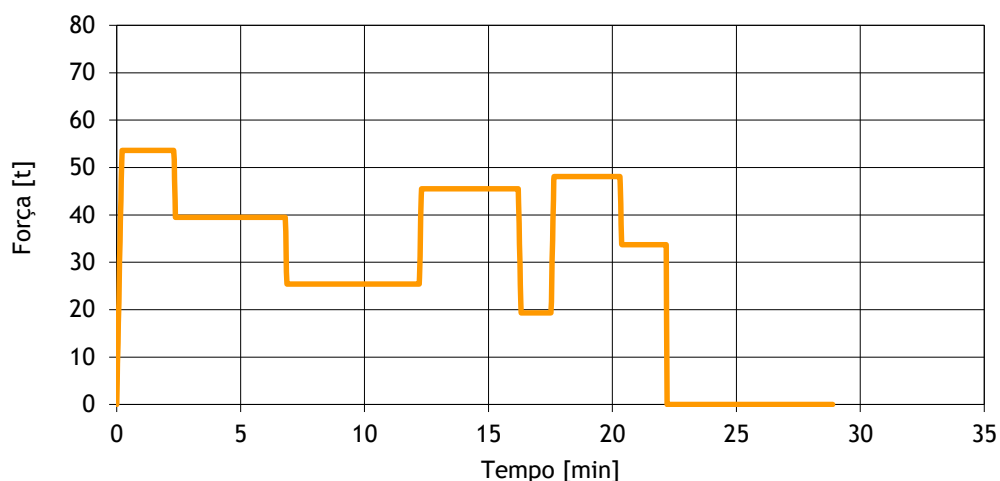
Rebocador 3 (80 t)



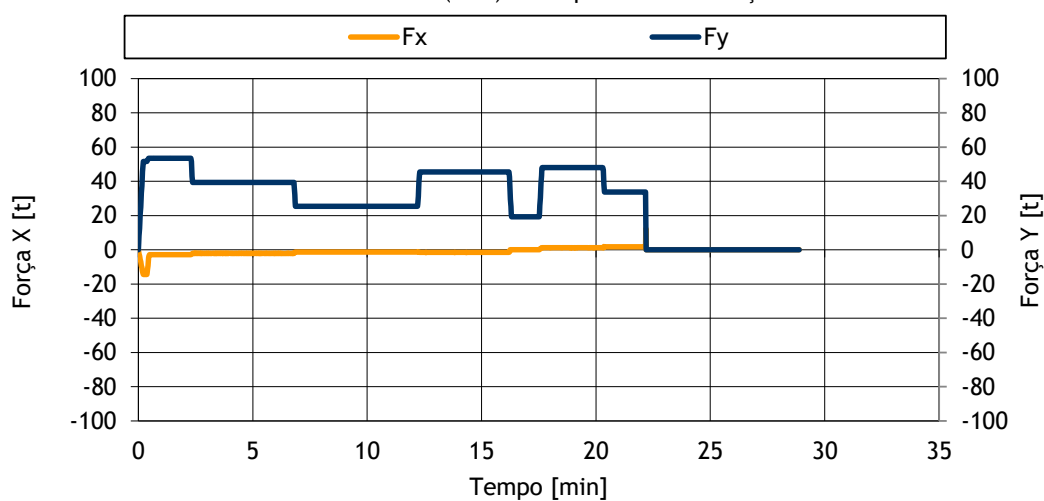
D-2006

Gráfico 7

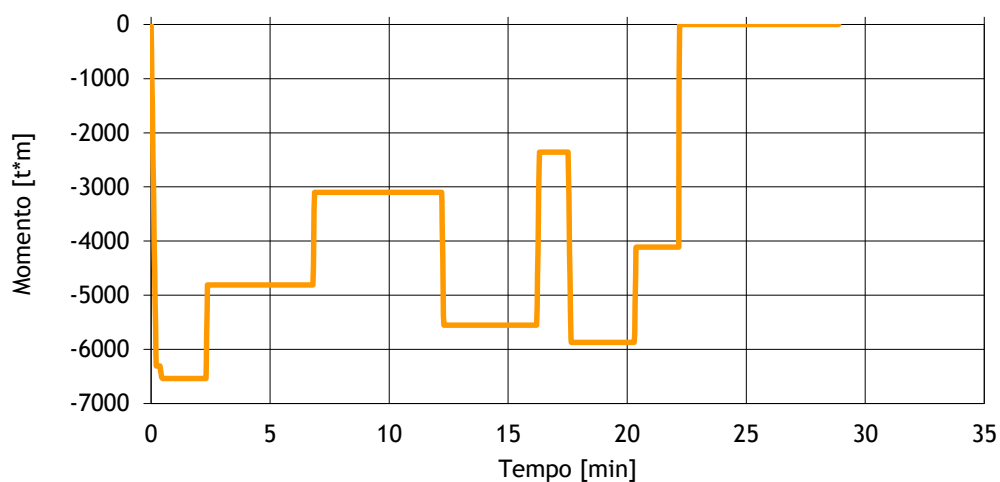
Rebocador 4 (25 t) - Força Total



Rebocador 4 (25 t) - Componentes da força



Rebocador 4 (25 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
 Vento: NE 25 kn, Ondas: NW Hs 2.0 m Tp 9 s
 RUN 2006
 Simulador de Manobras em Tempo Real

Rebocador 4 (25 t)



D-2006

Gráfico 8

RUN 2007

**Q-Flex LNG Carrier 216 000 m³. Lastro. Saída
direta**

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

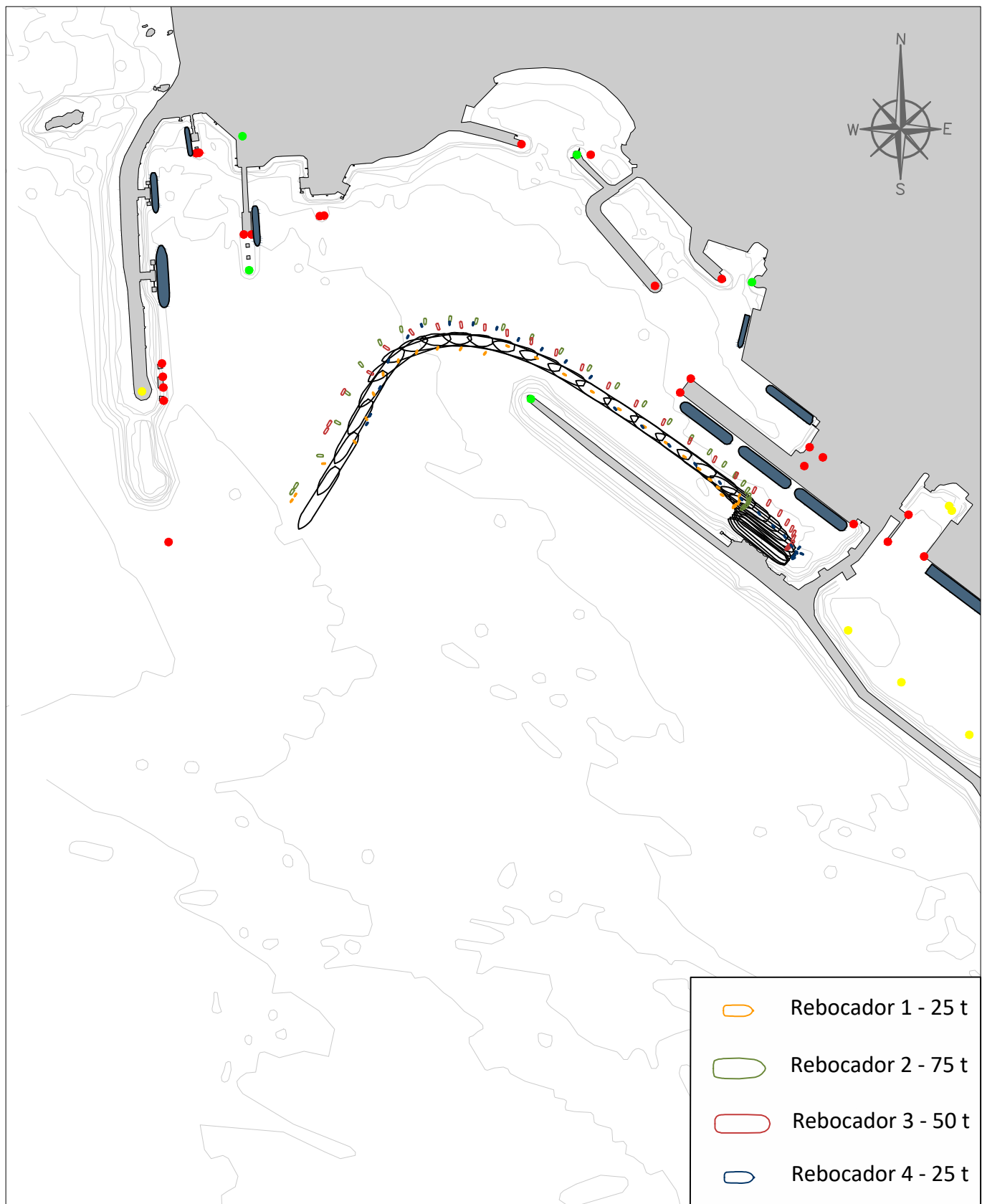


Figure: Trk-2007

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 6 000

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales

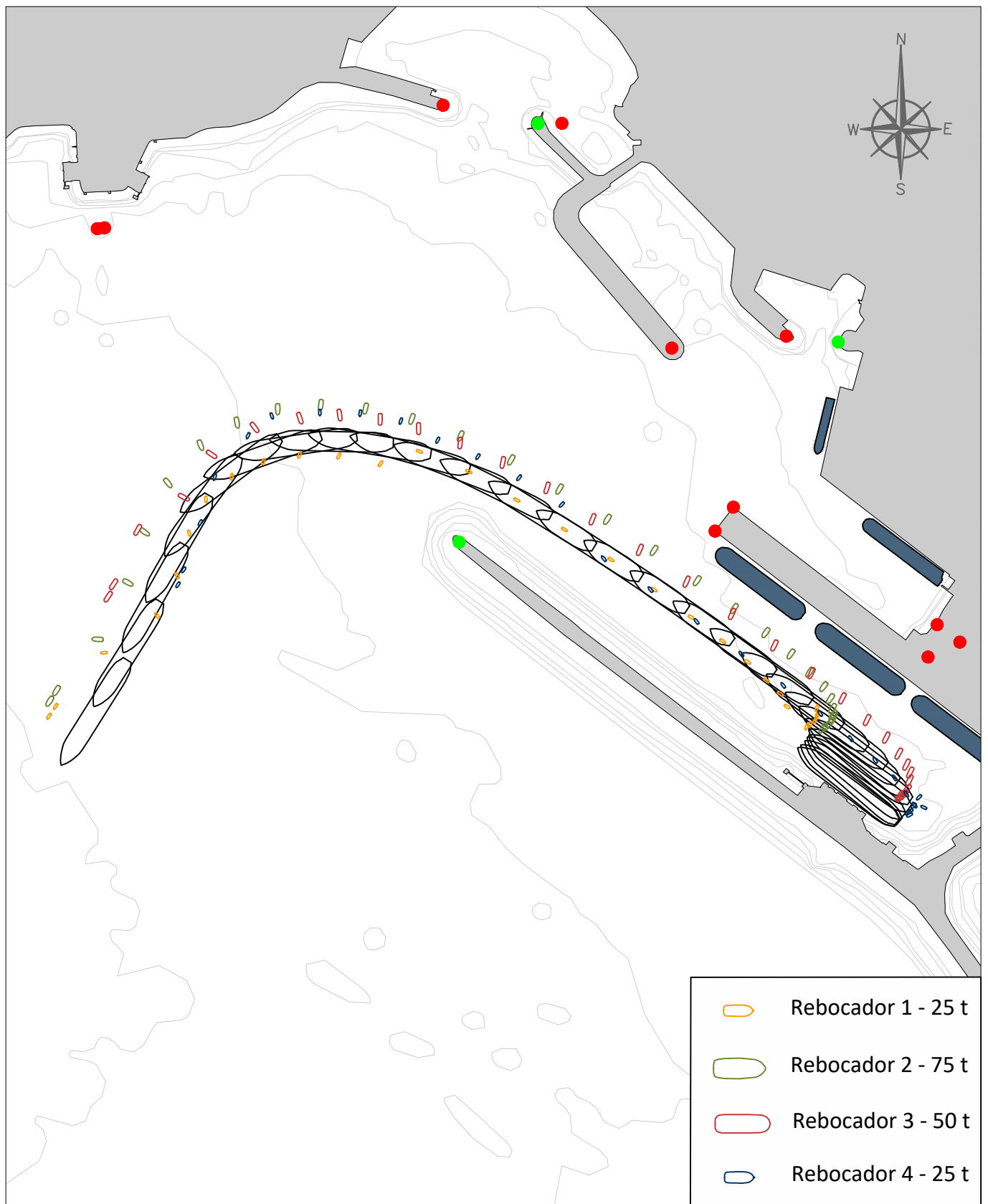


Figure: Trk-2007

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

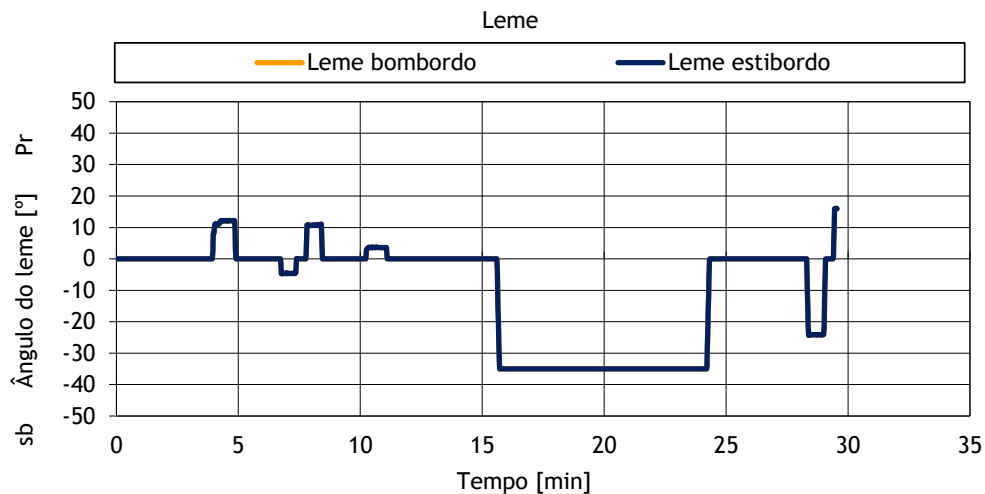
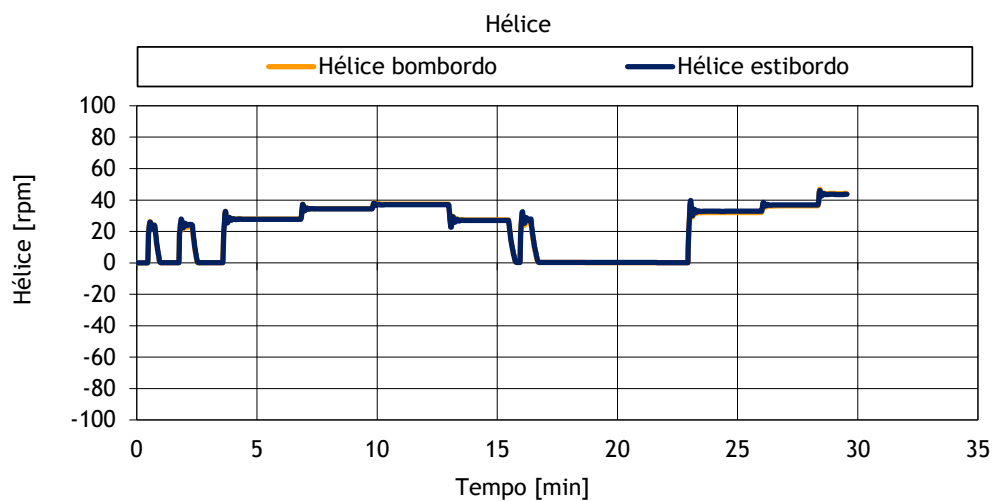
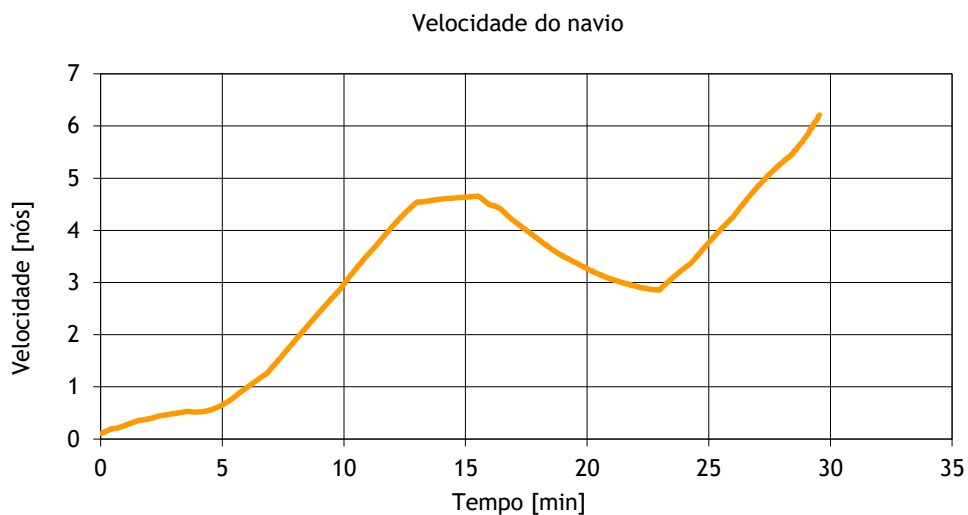
Gráfico de trajetória

Intervalo: 60 s

Escala: 1 : 3 500

Projeto: 2026064_Portugal_Sines_Consulmar_Adicionales





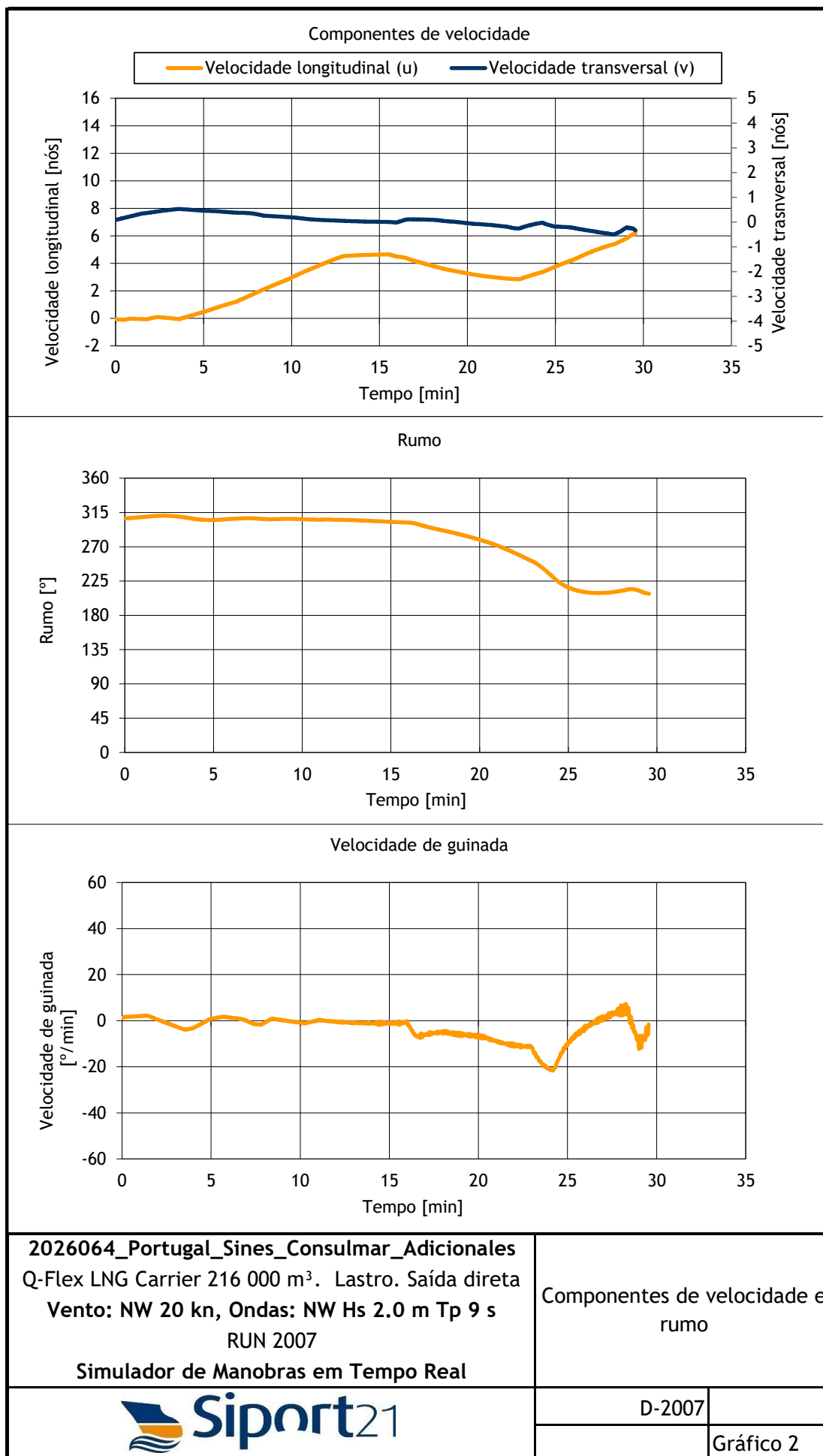
2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
 Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s
 RUN 2007
 Rebocadores: 4 (25 t + 75 t + 50 t + 25 t)

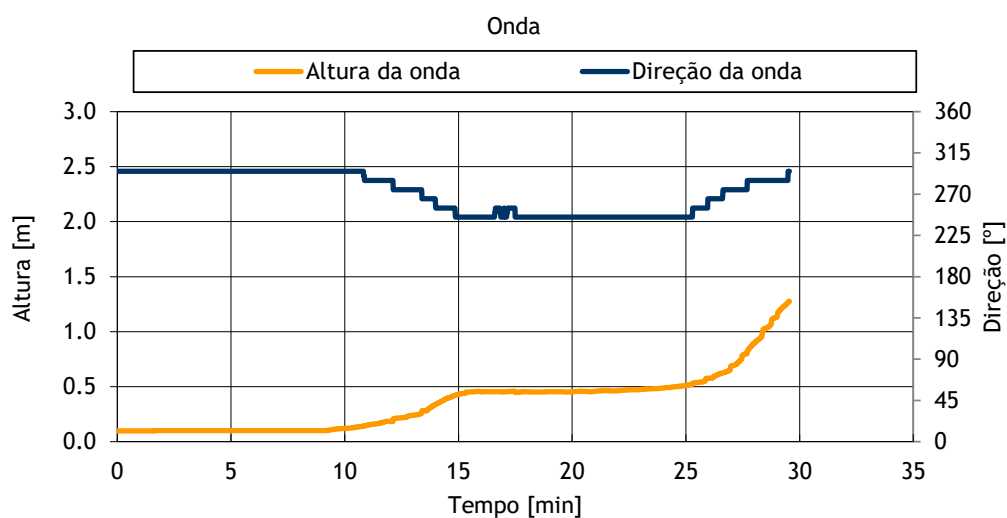
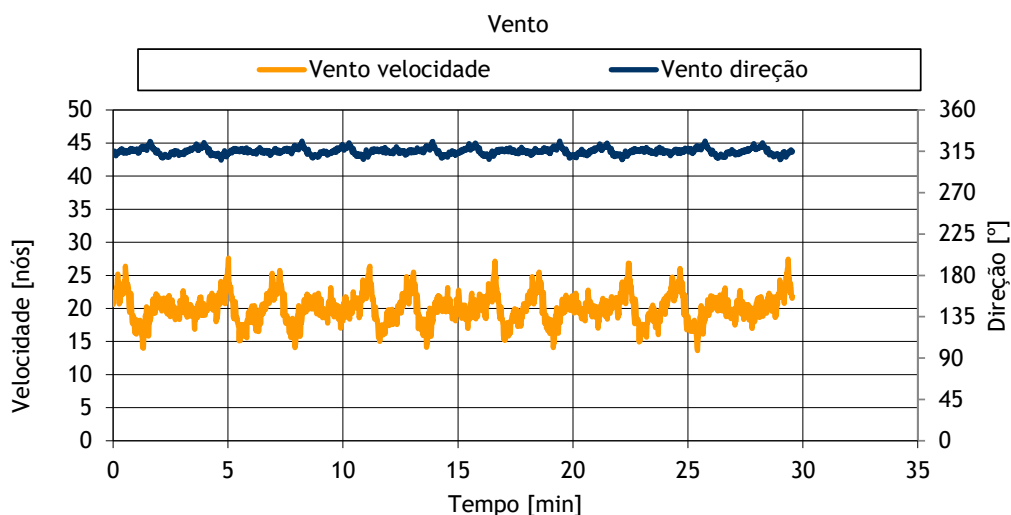
Velocidade, hélice e leme



D-2007

Gráfico 1





2026064_Portugal_Sines_Consulmar_Adicionales
Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 2007

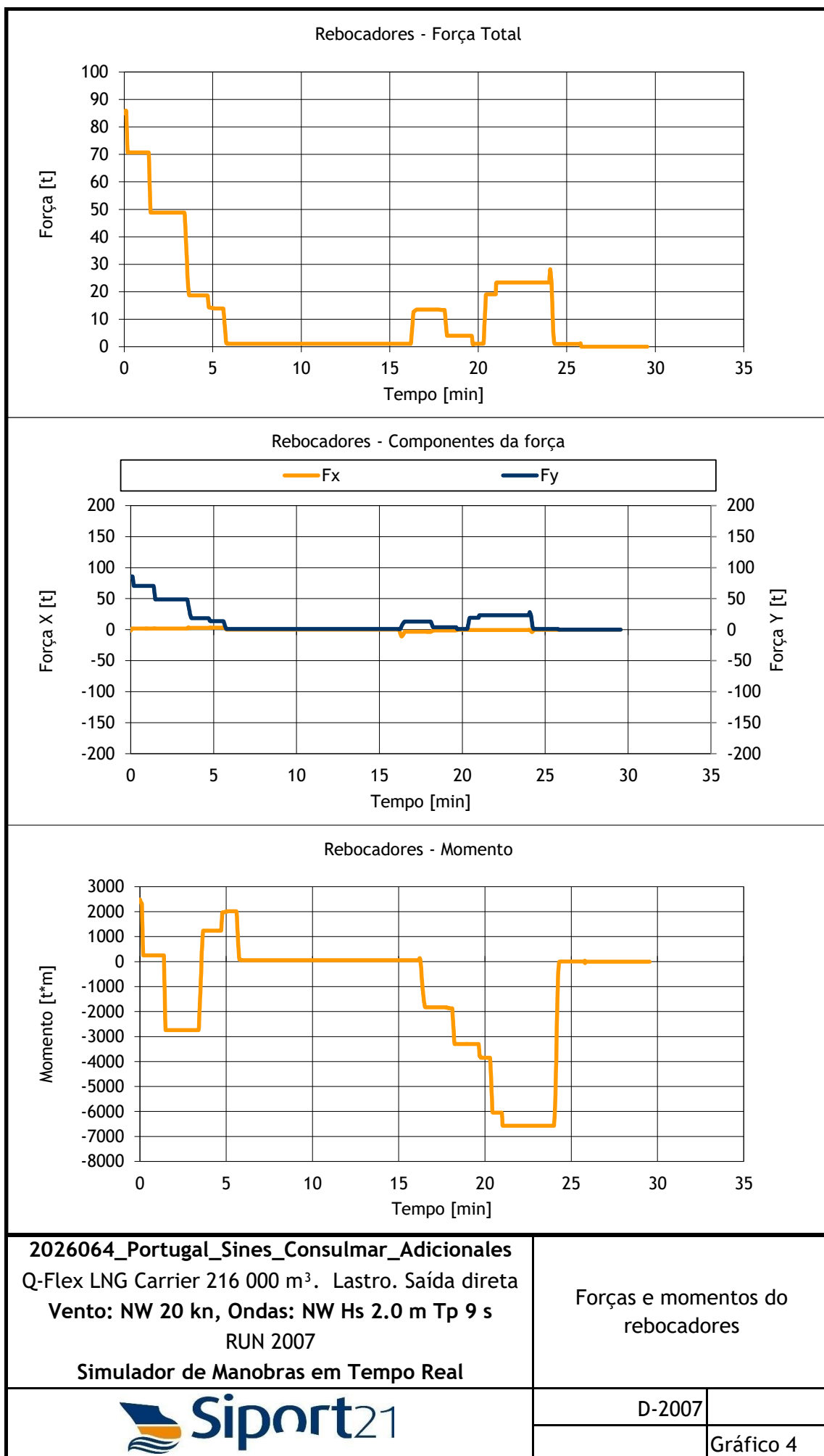
Simulador de Manobras em Tempo Real

Condições climáticas

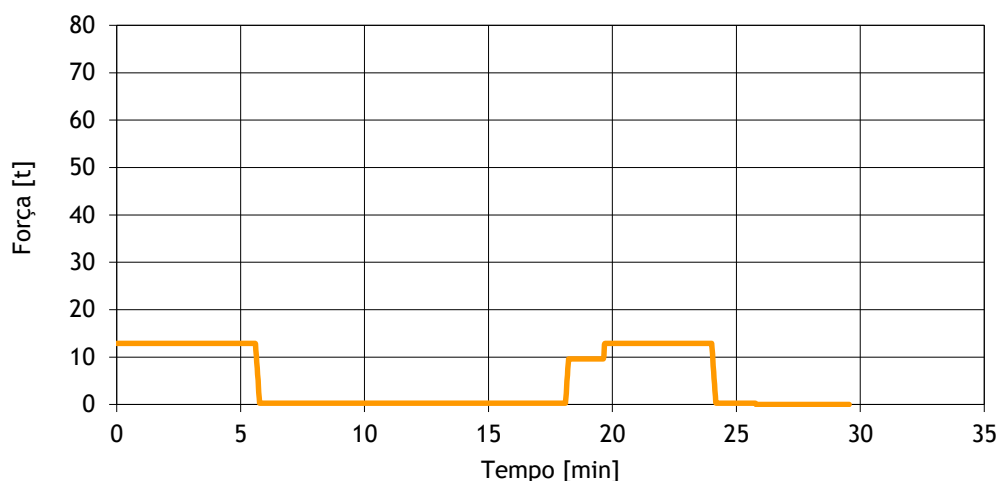


D-2007

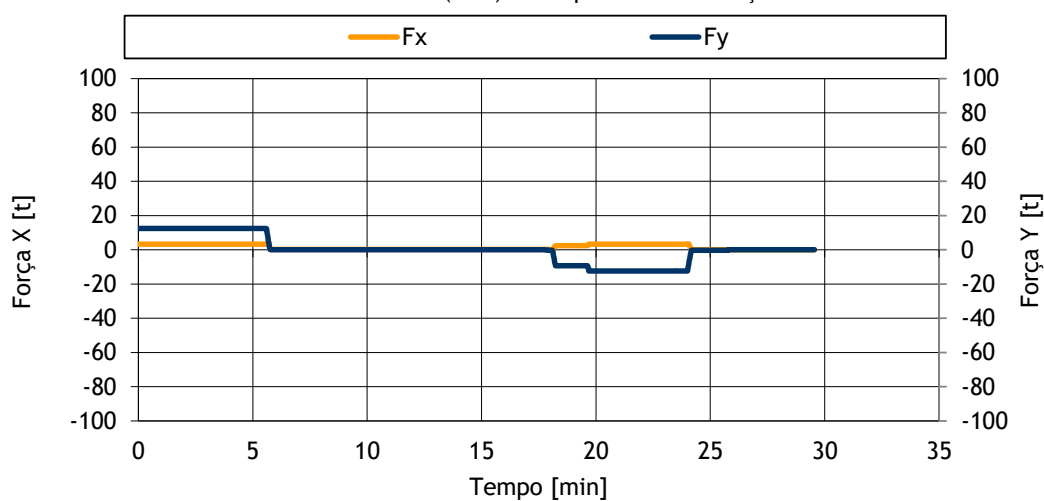
Gráfico 3



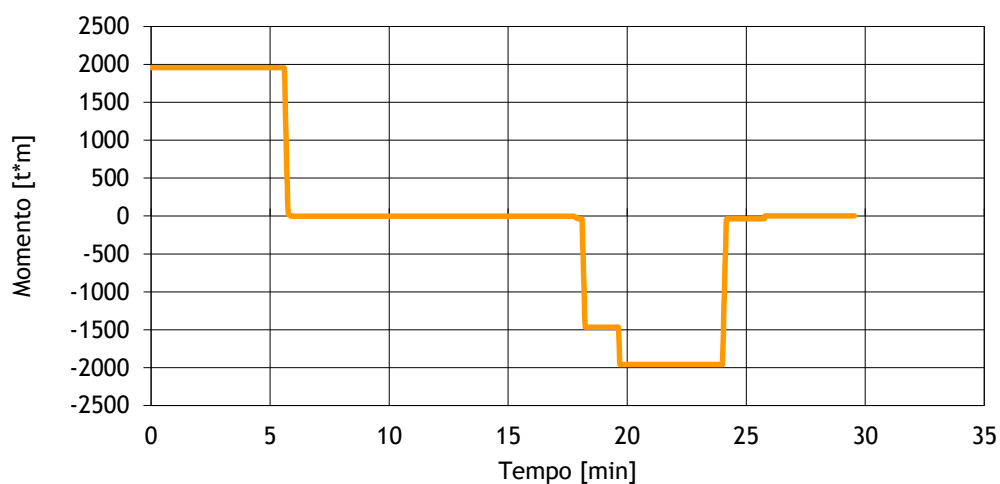
Rebocador 1 (25 t) - Força Total



Rebocador 1 (25 t) - Componentes da força



Rebocador 1 (25 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales
 Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
 Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s
 RUN 2007
 Simulador de Manobras em Tempo Real

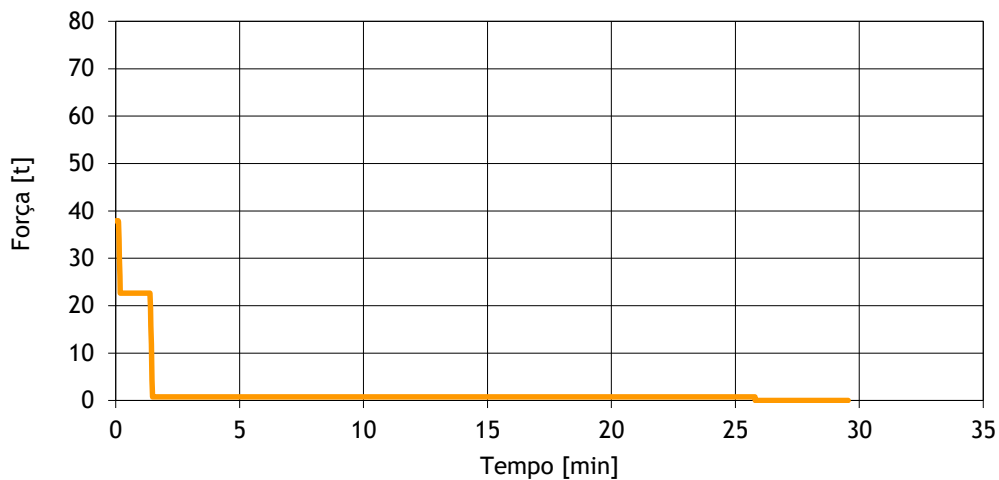
Rebocador 1 (25 t)



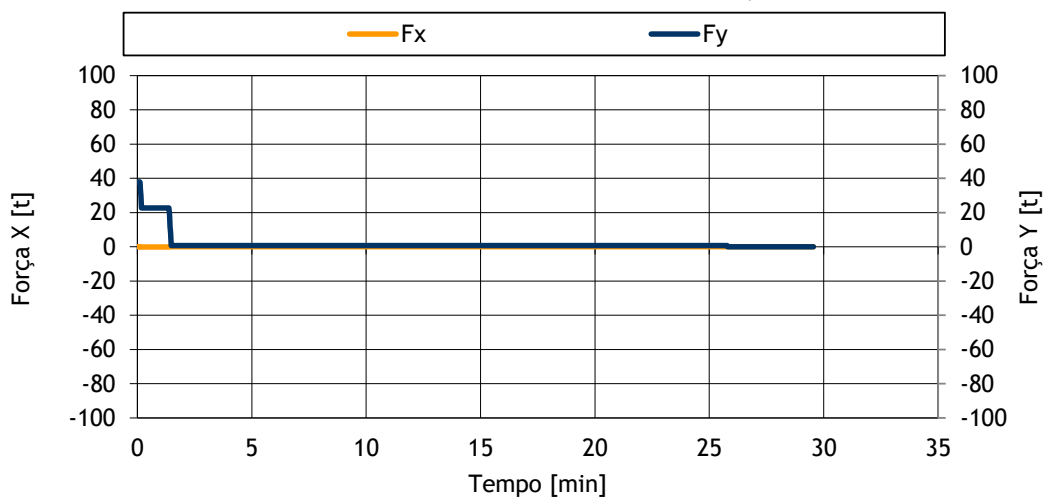
D-2007

Gráfico 5

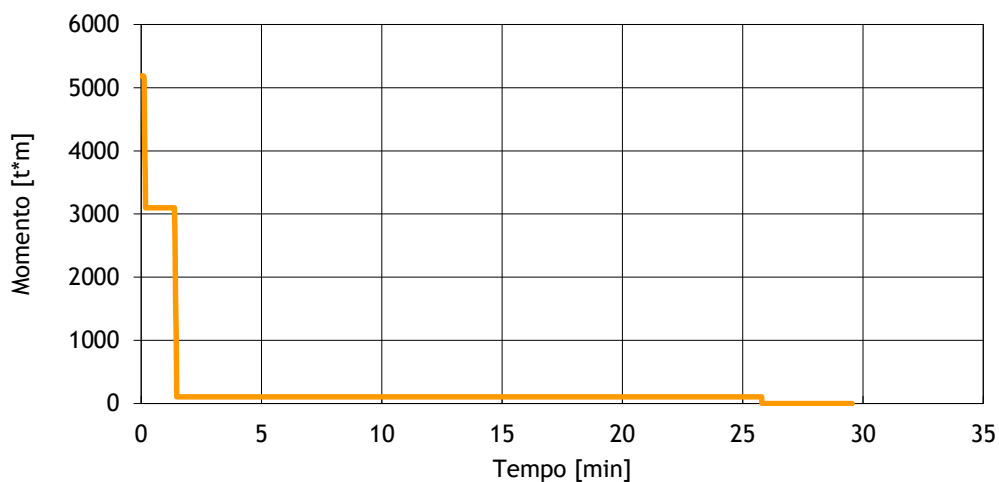
Rebocador 2 (75 t) - Força Total



Rebocador 2 (75 t) - Componentes da força



Rebocador 2 (75 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 2007

Simulador de Manobras em Tempo Real

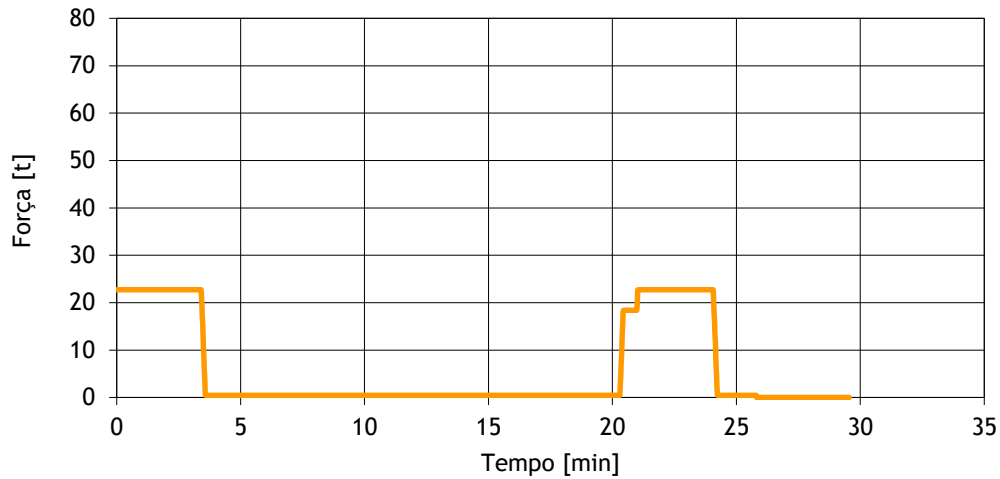
Rebocador 2 (75 t)



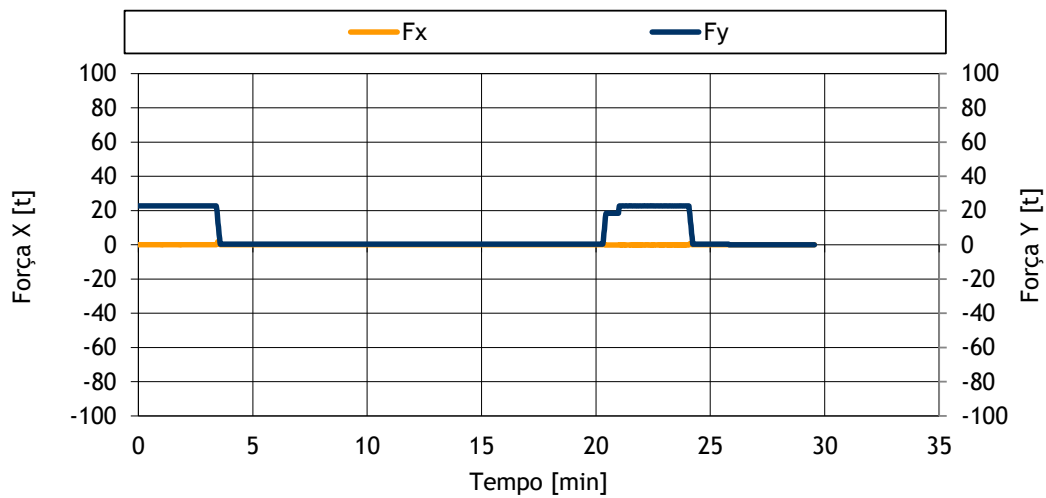
D-2007

Gráfico 6

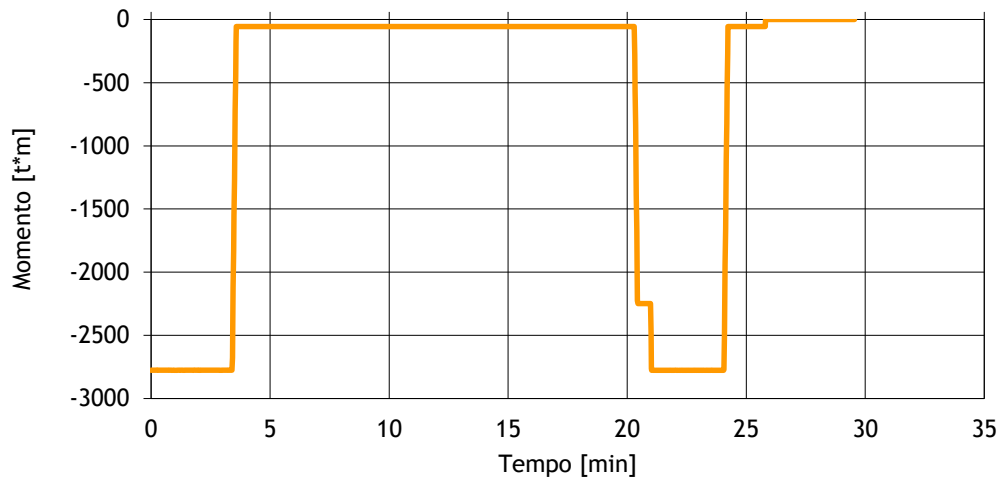
Rebocador 3 (50 t) - Força Total



Rebocador 3 (50 t) - Componentes da força



Rebocador 3 (50 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales
Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta
Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s
RUN 2007
Simulador de Manobras em Tempo Real

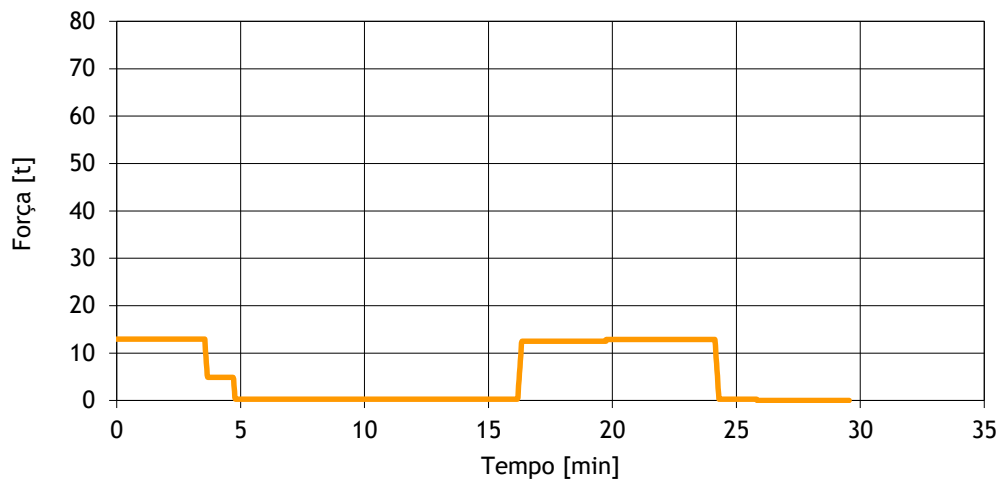
Rebocador 3 (50 t)



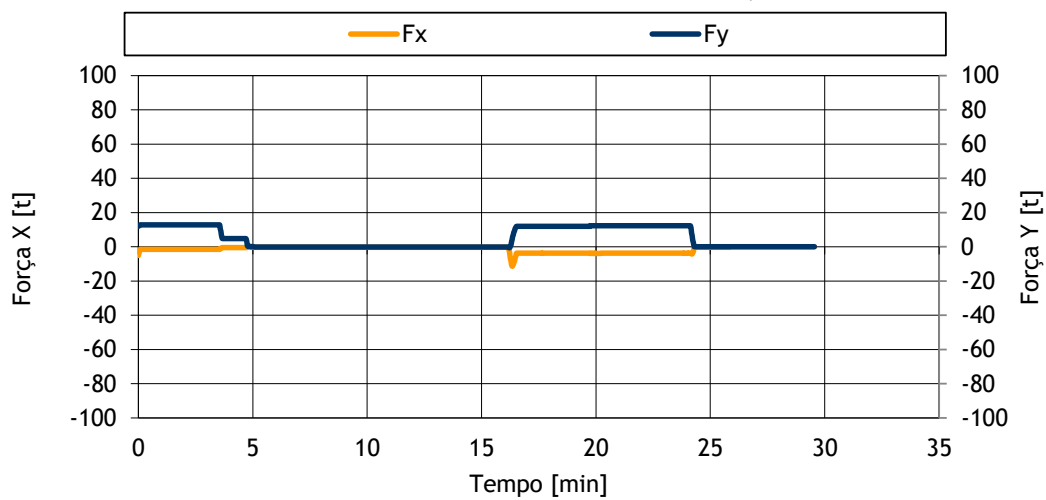
D-2007

Gráfico 7

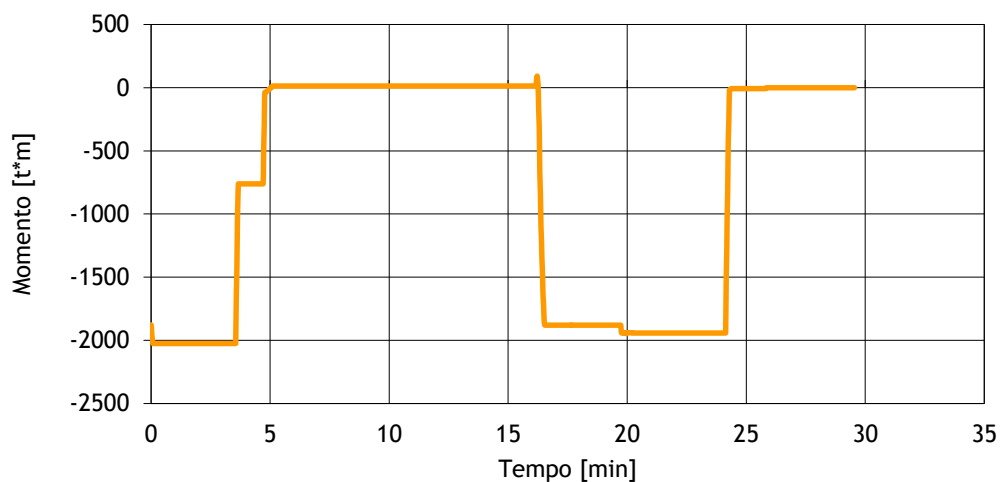
Rebocador 4 (25 t) - Força Total



Rebocador 4 (25 t) - Componentes da força



Rebocador 4 (25 t) - Momento



2026064_Portugal_Sines_Consulmar_Adicionales

Q-Flex LNG Carrier 216 000 m³. Lastro. Saída direta

Vento: NW 20 kn, Ondas: NW Hs 2.0 m Tp 9 s

RUN 2007

Simulador de Manobras em Tempo Real

Rebocador 4 (25 t)



D-2007

Gráfico 8