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MMA Pinnacle Vessel Safety Case

Safety Case Revision (Walk To Work Project)

Document Number – SV-ITS-OPS-VM-005

Rev 1	03.Apr.19	[redacted]	[redacted]	[redacted]
Revision	Revision Date	Document Author	Document Owner	Document Approver

AMENDMENTS

Revision	Date	Section	Description of Amendment
A	20.Jan.19	All	Issued for internal review
B	22.Jan.19	All	Issued for internal review
0	04.Feb.19	All	Issued to NOPSEMA
1	03.Apr.19	All	Issued to NOPSEMA in response to RFWI

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1. INTRODUCTION

This document presents a project specific Safety Case Revision (SCR) to the existing NOPSEMA[1] accepted safety case for the MMA Pinnacle vessel Facility [1] (Base Safety Case), addressing activities on the North West Shelf (NWS) providing Walk To Work (WTW) accommodation support services for Woodside. This is herein referred to as the WTW Project.

MMA Offshore (MMA) are the contract holder with Woodside. However, the MMA Pinnacle Facility will be operated in accordance with the arrangements detailed in its safety case, whereby Subsea 7 I-Tech Limited (Subsea 7) are the Operator of the Facility. As such, a service agreement is in place between MMA and Subsea 7 to ensure that Facility operations are conducted in accordance with Woodside requirements and the requirements of the Offshore Petroleum and Greenhouse Gas Storage Act (OPGGSA), 2006 [2].

This SCR is intended to be read in conjunction with the Base Safety Case (Subsea 7 document no: ITS-MA-VM-MMP-002) [1].

1.1 LEGISLATIVE BACKGROUND

The requirement for a vessel to have a safety case, whilst operating in Commonwealth waters, is established by the following:

- Commonwealth: Offshore Petroleum and Greenhouse Gas Storage Act (OPGGSA), 2006 [2]

The requirement for a SCR is established by the following Commonwealth regulations:

- Commonwealth: Offshore Petroleum and Greenhouse Gas Storage (Safety) (OPGGS(S)) Regulations, 2009 [3]

In a legislative context, OPGGS(S) regulation 2.30(1) establishes that a SCR must be submitted for MMA Pinnacle because:

- "*the activities to be carried out at the facility are different from the activities contemplated in the safety case*". In practical terms, the WTW Project requires the vessel to:
  - Operate as an accommodation support vessel, which is outside the scope of the Base Safety Case (as per Base Safety Case Introduction Section 1.3)
  - Potentially operate Drift-On to a platform, which is also outside the scope of the Base Safety Case
- "*the Operator proposes to modify or decommission the facility, and the proposed modification or decommissioning is not adequately addressed in the safety case*". In practical terms, the WTW Project requires the Facility to be equipped with a temporary motion compensated gangway system to facilitate WTW operations, which is not addressed in the Base Safety Case.

NOTE: Other sub-regulations within regulation 2.30 also apply in terms of why a SCR is required.

[1] National Offshore Petroleum Safety and Environmental Management Authority

For the purposes of the vessel operations under the scope of this SCR on the Project, the safety case comprises the following documents:

- MMA Pinnacle Vessel Safety Case (ITS-MA-VM-MMP-002)
- This document: MMA Pinnacle Vessel Safety Case, Safety Case Revision (Walk To Work Project) (SV-ITS-OPS-VM-005)

1.2 PURPOSE

The purpose of the SCR is to demonstrate to the satisfaction of the regulatory authority (NOPSEMA) that the risks associated with MMA Pinnacle activities on the WTW Project are reduced to a level that is As Low As Reasonably Practicable (ALARP).

1.3 SCOPE OF SAFETY CASE REVISION

MMA Pinnacle has been engaged by Woodside to provide WTW and accommodation support to Woodside's turnaround maintenance program during 2019. Tentatively, the work is scheduled for late April 2019 commencement, and will be of approximately one-month duration. The vessel will provide these services on the following Woodside NWS assets / facilities:

- Pluto Alpha (PLA) facility

NOTE: Scope may be extended to other platforms in future. If so, a safety case revision will be prepared in accordance with OPGGS(S) regulation 2.30.

To enable MMA Pinnacle to safely provide WTW services in the field of concern, the vessel will be temporarily equipped with a motion compensated offshore gangway system. The vessel will conduct the following operations on the WTW Project:

- Transfer of WTW Personnel to / from the adjacent platform using the gangway system, as described in Section 2
- Other general support activities (storage of equipment on deck, bunkering fresh water to the platform)

The following is specifically excluded from the scope of WTW Project operations, hence excluded from the safety case:

- Lifting operations using the gangway boom tip mounted hoist

It is noted that the Base Safety Case does permit vessel operations within the 500m zone of hydrocarbon containing platforms, and a wide range of other marine operations, as detailed in Base Safety Case Introduction Section 1.3.

The Base Safety Case Introduction Section 1.3 does stipulate that under the Base Safety Case the vessel must be Drift-Off with respect to hydrocarbon containing topsides or floating facilities. As such, this SCR is intended to address this Base Safety Case exclusion on the WTW Project only. This reflects the potential for possible gangway operations whilst Drift-On to PLA, although systems and processes are in place to avoid this as far as practicable.

1.4 DEFINITIONS

Term	Definition
Base Safety Case	Referring to the existing safety case for MMA Pinnacle (Subsea 7 document no: ITS-MA-VM-MMP-002 Revision 1) [1], which was updated following acceptance of the Revision 0 document by NOPSEMA to reflect the changes agreed with NOPSEMA within the Requests for Further Written Information (RFWI).
Facility	The use of the term Facility is that defined in the OPGGS Act [2], in Volume 2, Schedule 3, Introduction, as per the extract below: "(1) A vessel or structure is taken to be a Facility for the purposes of this Schedule while that vessel or structure: (a) is located at a site in Commonwealth waters; and (b) is being used, or prepared for use, at that site: (iii) for drilling or servicing a well for petroleum or doing work associated with the drilling or servicing process; or (iv) for laying pipes for petroleum, including any manufacturing of such pipes, or for doing work on an existing pipe; or (v) for the erection, dismantling or decommissioning of a vessel or structure referred to in a previous subparagraph of this paragraph; or (vi) for any other purpose related to offshore petroleum operations that is prescribed for the purposes of this subparagraph"
Operator	The use of the term Operator is that defined in the OPGGS Act [2], in Volume 2, Schedule 3, Introduction, as per the extract below: "(1) For the purposes of this Schedule, the Operator, in relation to a Facility or proposed Facility, is the person who, under the regulations, is registered by NOPSEMA as the operator of that Facility or proposed Facility." NOTE: Subsea 7 I-Tech Limited is the Operator of the Facility.
Subsea 7	Refers to the global group of companies that operate as wholly owned subsidiaries of Subsea 7 A.S, and includes the Facility Operator Subsea 7 I-Tech Limited.
Major Accident Event (MAE)	An event connected with a Facility, including a natural event, having the potential to cause multiple fatalities of persons at or near the Facility (OPGGS(S) regulation 1.5). Abbreviated to 'MAE' within the document.
Drift-Off	Referring to the vessel being positioned such that if propulsion or thrust was lost (i.e. due to a blackout) then the combined environmental force on the vessel would result in the vessel drifting past or away from the respective obstruction.
Drift-On	Referring to the vessel being positioned such that if propulsion or thrust was lost (i.e. due to a blackout) then the combined environmental force on the vessel would result in the vessel drifting into contact with the respective obstruction.
Woodside	Refers to Woodside Energy Limited, which on behalf of Woodside Burrup Pty Ltd, operates the Pluto-A Facility under the OPGGS Act.

WTW Personnel	Referring to the special personnel on board the vessel for accommodation purposes only, but who do not undertake any actual work on the vessel.
Pluto Safety Case	The term is used to refer to the Pluto-A Facility Safety Case for Operations [4], as will be in force on PLA during the WTW Project, following NOPSEMA acceptance of the document to include WTW operations.

1.5 ABBREVIATIONS

ALARP	As Low As Reasonably Practicable
ASOG	Activity Specific Operating Guideline
BMS	Business Management System
BOSIET	Basic Offshore Safety Induction and Emergency Training
BV	Bureau Veritas
CCF	Common Causal Factor
CFD	Computational Fluid Dynamics
CCTV	Closed-Circuit Television
Class Rules	Classification Society Rules
CSR	Company Site Representative
DNVGL	Det Norske Veritas Germanischer Lloyd
DP	Dynamic Positioning
DPO	Dynamic Positioning Officer
ECR	Engine Control Room
EEBD	Emergency Escape Breathing Device
EER	Escape, Evacuation and Rescue
EERA	Escape, Evacuation and Rescue Analysis
ERP	Emergency Response Plan
ESD	Emergency Shutdown
ESSA	Emergency Systems Survivability Analysis
FD	Facility Description
FEA	Fire and Explosion Analysis
FMEA	Failure Mode and Effects Analysis
FRC	Fast Rescue Craft
FSA	Formal Safety Assessment
GA	General Alarm
GMDSS	Global Maritime Distress Safety System
HAZID	Hazard Identification
HIRA	Hazard Identification and Risk Assessment
HMI	Human Machine Interface
HPU	Hydraulic Power Unit
Hs	Significant Wave Height
HSE	Health, Safety and Environment
HSEQ	Health, Safety, Environment and Quality
HSSE	Health, Safety, Security and Environment
HSSEMP	Project Health, Safety, Security and Environment Management Plan
HUET	Helicopter Underwater Escape Training
HVAC	Heating, Ventilation and Air Conditioning System
ID	Identification

IMCA	International Marine Contractors Association
ITP	Inspection and Test Plan
LED	Light-Emitting Diode
LNG	Liquified Natural Gas
MAE	Major Accident Event
MMA	MMA Offshore
MOB	Man Over Board
MOPS	Manual Overload Protection System
MRU	Motion Reference Unit
mT	Metric Tonne
NDE	Non-Destructive Examination
NFHA	Non Flammable Hazard Assessment
NFPA	National Fire Protection Agency
NNM	Not Normally Manned
NOPSEMA	Australian National Offshore Petroleum Safety and Environmental Management Authority
NR	Not Required
NRV	Non Return Valve
NV	Not Vulnerable
NWS	North West Shelf
OAS	Certification of Offshore Access Systems
OM	Offshore Manager (also known as Offshore Construction Manager)
OPGGS	Offshore Petroleum and Greenhouse Gas Storage
OPGGSA	Offshore Petroleum and Greenhouse Gas Storage Act
OPITO	Offshore Petroleum Industry Training Organization
PA	Public Address
PIC	Person In Charge
PLA	Pluto Alpha
PLB	Personal Locator Beacon
PLC	Programmable Logic Controller
POB	Personnel On Board
PPE	Personal Protective Equipment
PTW	Permit To Work
RESDV	Riser Emergency Shut Down Valves
RFWI	Requests for Further Written Information
ROV	Remotely Operated Vehicle
RPC	Risk Priority Code
RPM	Revolutions Per Minute
SCBA	Self-Contained Breathing Apparatus
SCE	Safety Critical Equipment
SCP	Safety Critical Procedure
SCR	Safety Case Revision
SDV	Shutdown Valve
SIMOPS	Simultaneous Operations
SMS	Safety Management System
SOLAS	International Convention for the Safety of Life At Sea
SPS	Special Purpose Ship
SSSV	Subsurface Safety Valve

STCW	Standards of Training, Certification and Watchkeeping for Seafarers
SWL	Safe Working Load
TBOSIET	Tropical Basic Offshore Safety Induction and Emergency Training
UHF	Ultra High Frequency
UPS	Uninterruptable Power Supply
VHF	Very High Frequency
WTW	Walk To Work

1.6 FACILITY BACKGROUND

1.6.1 Facility Operator

Subsea 7 I-Tech Limited is the registered Operator of MMA Pinnacle. The term Subsea 7 is used to refer to the Operator, and to the broader global parent company under which the associated entities operate, who share a common Business Management System (BMS). MMA Offshore (MMA) is the marine management entity for the vessel in Australia.

This arrangement is further described in Base Safety Case, Part 1 Introduction, Section 2.2.

1.6.2 Facility Overview

MMA Pinnacle is an 87.8m long modern diesel-electric monohull Dynamic Positioning (DP) class 2 multipurpose offshore support vessel designed for unrestricted global operations. It is equipped with a forward helideck, a large open back deck for project equipment, a moonpool, a 150mT crane, Remotely Operated Vehicles (ROVs), and considerable below deck storage for various dry and liquid cargo.

The vessel was designed by Wartsila and built by Jaya Shipbuilding in Jaya Asiatic Shipyard (Batam, Indonesia), commencing in 2014. Construction was completed in late 2016. The vessel is currently classed, maintained, and compliant in accordance with Det Norske Veritas Germanischer Lloyd (DNVGL) Rules for Classification of Ships [5].

Further information regarding the vessel is provided in Base Safety Case, Part 2 Facility Description.

For the WTW Project, the vessel will be equipped with a temporary Safeway Seagull motion compensated gangway system, installed on the back deck. An overview brochure for the gangway is provided in Appendix A. The system is described in Section 2.3 The gangway system is removed from the vessel when it is not operating on the WTW Project.

1.7 SAFETY CASE REVISION CONTENT

The SCR format adheres to the same four-part format as the Base Safety Case. Each part is presented in a separate section of the SCR document, as follows:

- Section 1: Introduction
- Section 2: Facilities and Activities Description
- Section 3: Safety Management System Description

- Section 4: Formal Safety Assessment Description

In general, a similar document structure has also been maintained within each section, in comparison to the Base Safety Case. A brief description of each section is provided below:

- Section 1 of the SCR (this part) provides an overview of the vessel, legislative background for the SCR, scope, content and structure of the SCR.
- Section 2 of the SCR describes the field and vessel activities associated with the WTW Project, in addition to any additional vessel equipment and hardware-based controls, including Safety Critical Equipment (SCE) associated with the WTW Project.
- Section 3 of the SCR describes the safety management system that applies to the vessel on the WTW Project, by bridging to the Base Safety Case, and describing any additional arrangements or Safety Critical Procedures (SCP) that apply.
- Section 4 of the SCR describes the Formal Safety Assessment (FSA) which has identified any additional Major Accident Event (MAE) associated with the scope of the SCR, assessed them in a systematic manner, and demonstrates that the residual risk is ALARP. The FSA also identifies the role the various SCE and SCP fulfil in reducing risk to ALARP.

Figure 1: Vessel Photograph

1.8 REFERENCING ARRANGEMENTS

Within each part of the SCR, reference to other sections of the SCR is provided using traditional section cross references (e.g. Section 3.4, Section 4.2).

However, when referencing the Base Safety Case within the SCR, the below convention is adopted, and the reference text is in blue for clarity.

Base Safety Case Part 1 Introduction, Section 1.1	Base Safety Case Introduction Section 1.1

Base Safety Case Part 2 Facility Description, Section 1.1	Base Safety Case FD Section 1.1
Base Safety Case Part 3 Safety Management System Description, Section 1.1	Base Safety Case SMS Section 1.1
Base Safety Case Part 4 Formal Safety Assessment, Section 1.1	Base Safety Case FSA Section 1.1

1.9 WORKFORCE CONSULTATION AND INVOLVEMENT

This SCR was developed by Subsea 7 personnel, MMA personnel and specialist consultants. There was extensive consultation with the workforce and Woodside throughout the development process which included:

- FSA related workshops
- SCR review process
- Frequent meetings with Woodside

Further information regarding workforce participation is provided in Section 4.1.4.

1.10 VALIDATION

Validation of WTW Project SCE will be undertaken in accordance with the regulations and process outlined in Base Safety Case Introduction Section 5.

The extent of vessel and equipment validation for the WTW Project is detailed in the MMA Pinnacle, Scope of Validation, Walk To Work Project [6]. The outcome of the WTW Project validation process is reflected in a validation statement provided by the validator and issued to NOPSEMA prior to SCR acceptance.

1.11 SAFETY CASE MANAGEMENT

Safety case document management for the SCR adheres to the same process and requirements as the Base Safety Case, as outlined in Base Safety Case Introduction Section 6. This SCR is essentially considered part of the Base Safety Case, once accepted, for the duration of the Project.

2. FACILITIES AND ACTIVITIES DESCRIPTION

This section of the SCR describes the following:

- The host-facility at which the vessel will provide the WTW Project services
- The vessel gangway related activities associated with the WTW Project
- The gangway system on the vessel during the WTW Project, and any other changes to the vessel on the WTW Project

The scope of the SCR is limited to the vessel providing WTW accommodation support services at the following platform during Woodside's turnaround maintenance programs:

- PLA platform

A brief description of the above host-platform is provided below to identify the key attributes that are relevant to demonstrating the WTW Project risk to the vessel is ALARP.

2.1 PLUTO ALPHA PLATFORM

2.1.1 Overview

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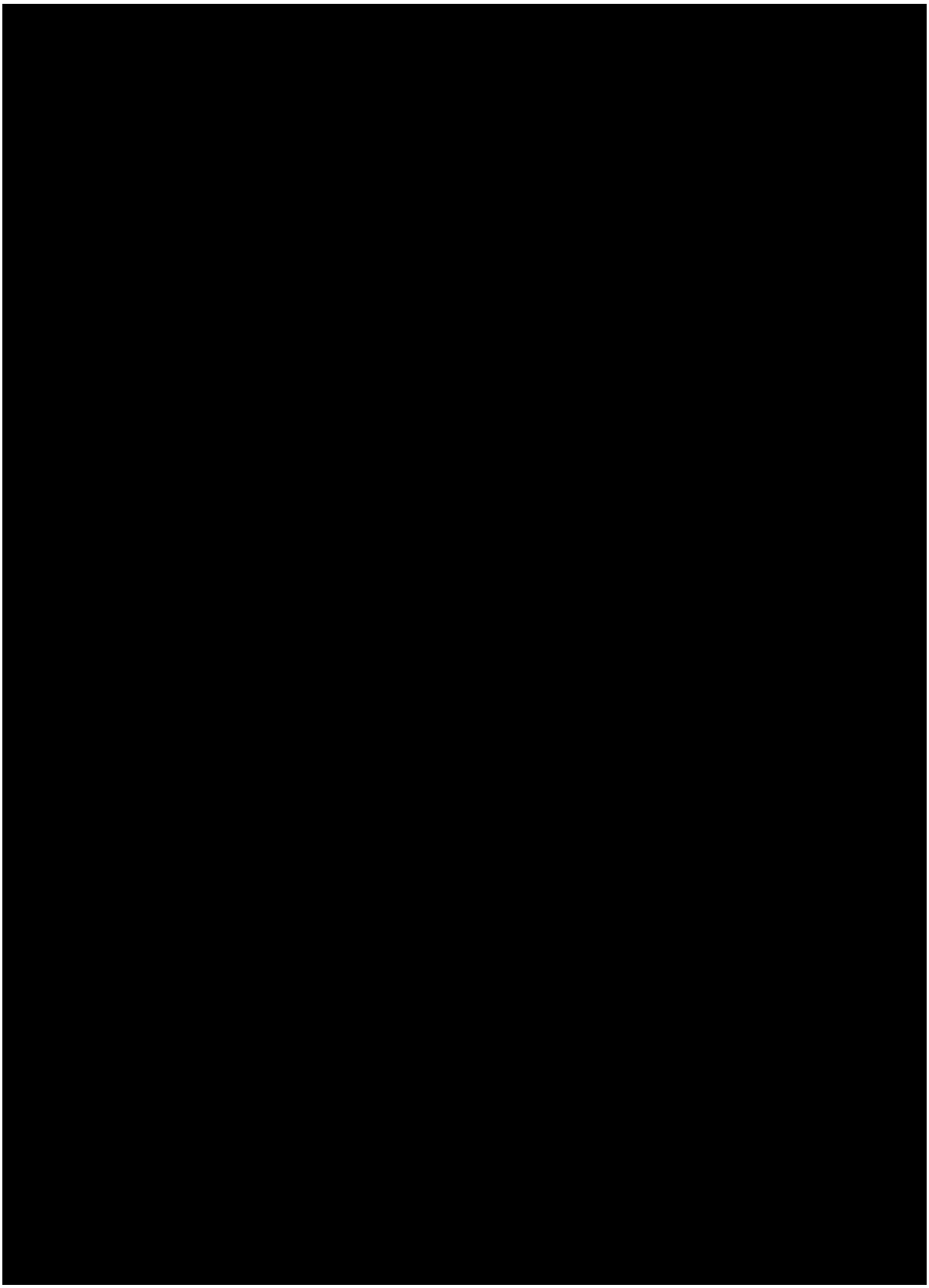

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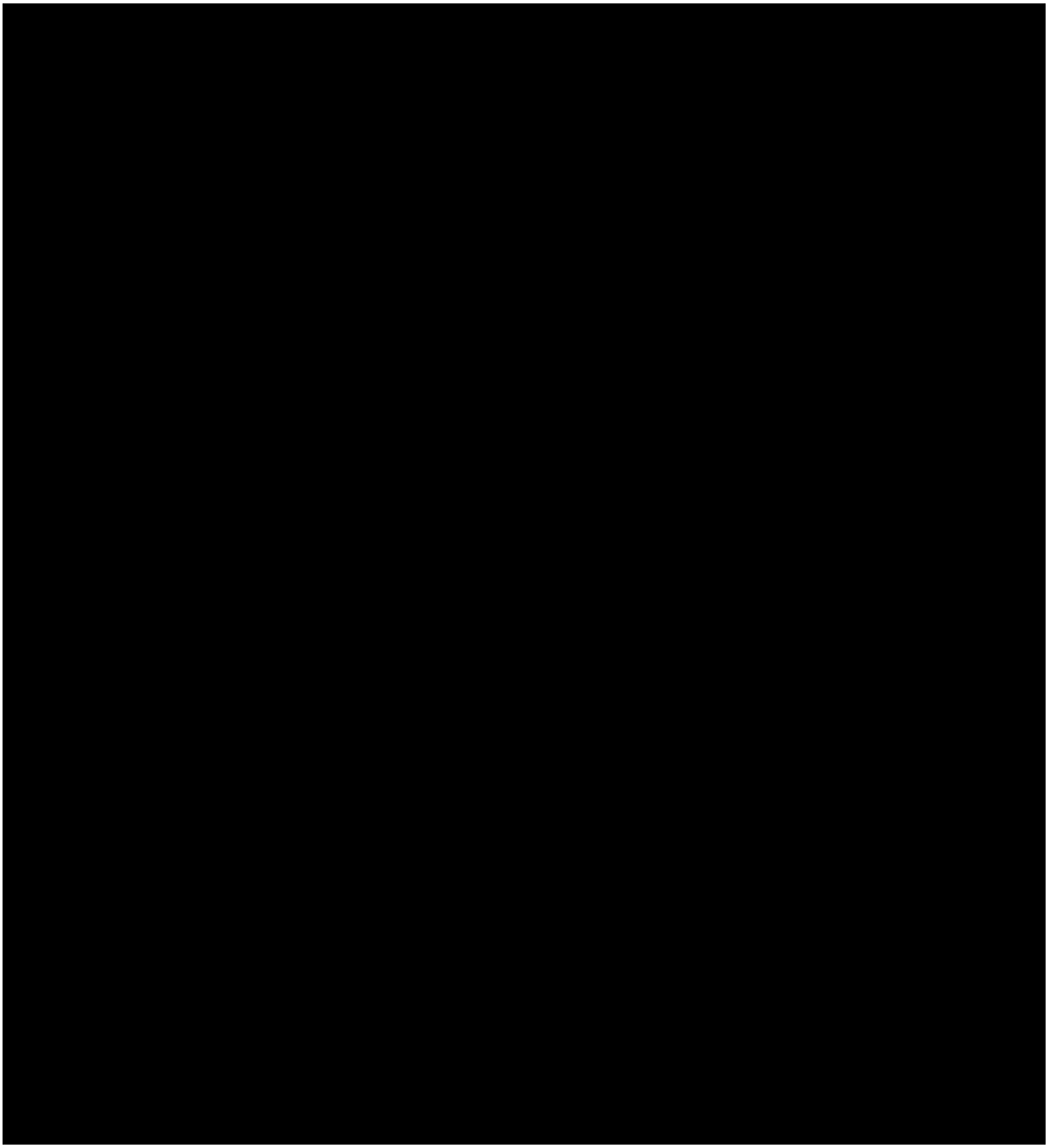

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2.2 ACCOMMODATION SUPPORT / WTW ACTIVITIES

2.2.1 Overview

The scope of MMA Pinnacle offshore activities on the WTW Project, that are outside the scope of the Base Safety Case, comprises providing WTW services to enable transfer of WTW Personnel between the vessel and an adjacent platform.

The general marine operations, crane operations, helicopter operations, and onboard accommodation support services are encompassed by the Base Safety Case.

The vessel is not required to provide any installation, inspection, maintenance or repair services whilst operating as the WTW accommodation support vessel. However, some cargo handling operations are anticipated (i.e. cargo supply to the platform).

Deck crane and platform crane operations are not permitted during gangway operations.

2.2.2 Vessel Manning

The anticipated manning arrangement during the WTW Project is indicated in Table 2. The marine crew manning shall include sufficient personnel such that both the vessel rescue boats can be manned without detriment to other critical vessel functions.

The below manning is aligned with the minimum requirements detailed in Base Safety Case FD Section 2.5.5. The manning by one Gangway Operator also complies with applicable Subsea 7 and MMA fatigue management standards outlined in Base Safety

Case SMS Section 9.2. The Gangway Operator and Banksman are only required to fulfil duties prior to, during and just after each personnel transfer operation. At other times, the vessel is outside the 500m zone.

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2.3 MMA PINNACLE WTW PROJECT GANGWAY SYSTEM

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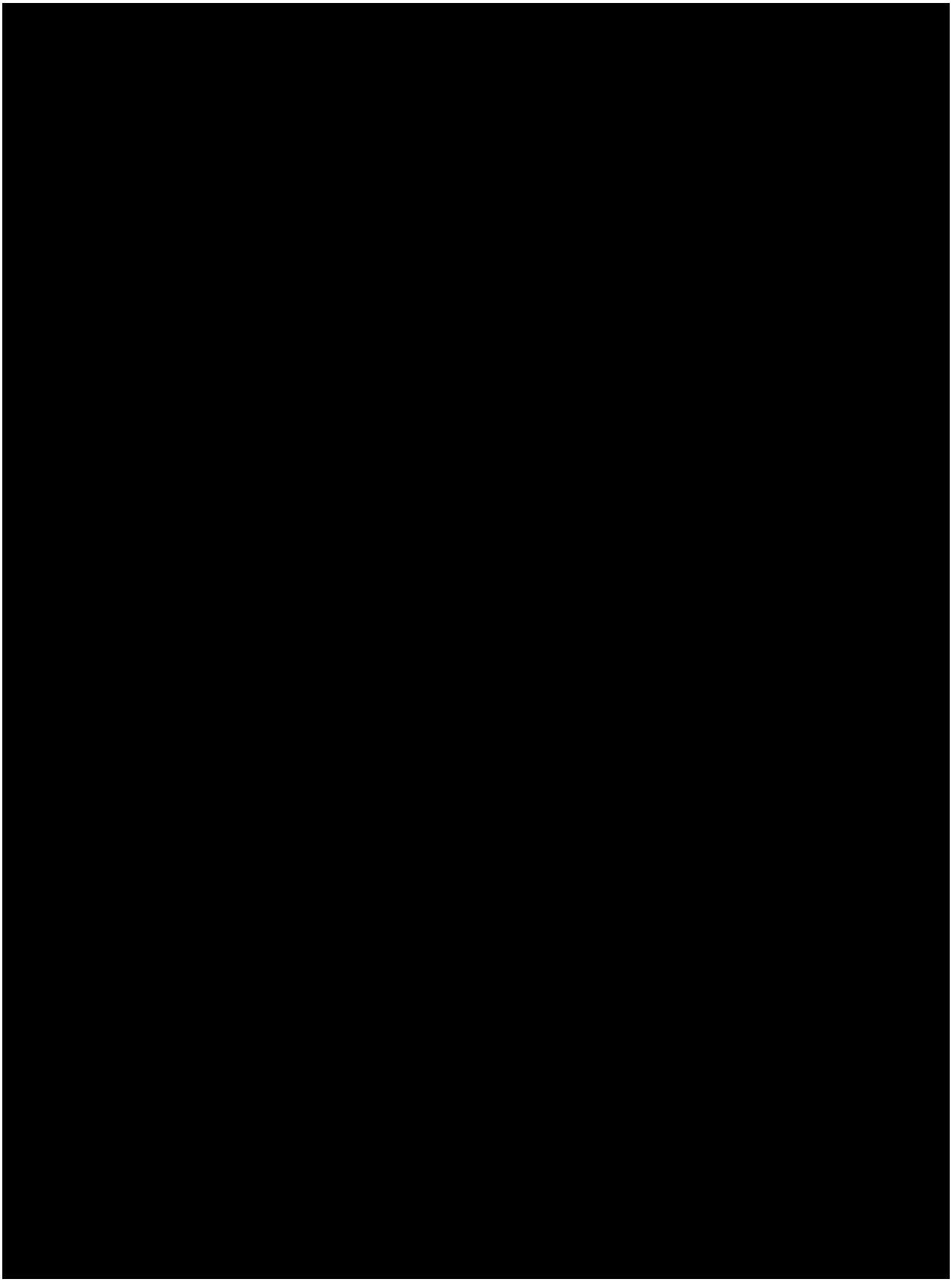
2 Also known as the gangway's pedestal, as distinct from the vessel's pedestal structure below



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2.3.2.4 Vessel Stability

The vessel's stability book will be updated with an addendum to reflect the position and centre of gravity for the gangway to ensure adequate stability during all gangway operations. As part of this process, it has been established that the vessel stability parameters are not particularly sensitive to changes in gangway elevation.

Stability calculations, as described in Base Safety Case FD Section 3.1, will also reflect the gangway loading on the vessel.

2.3.3 Safeway Gangway

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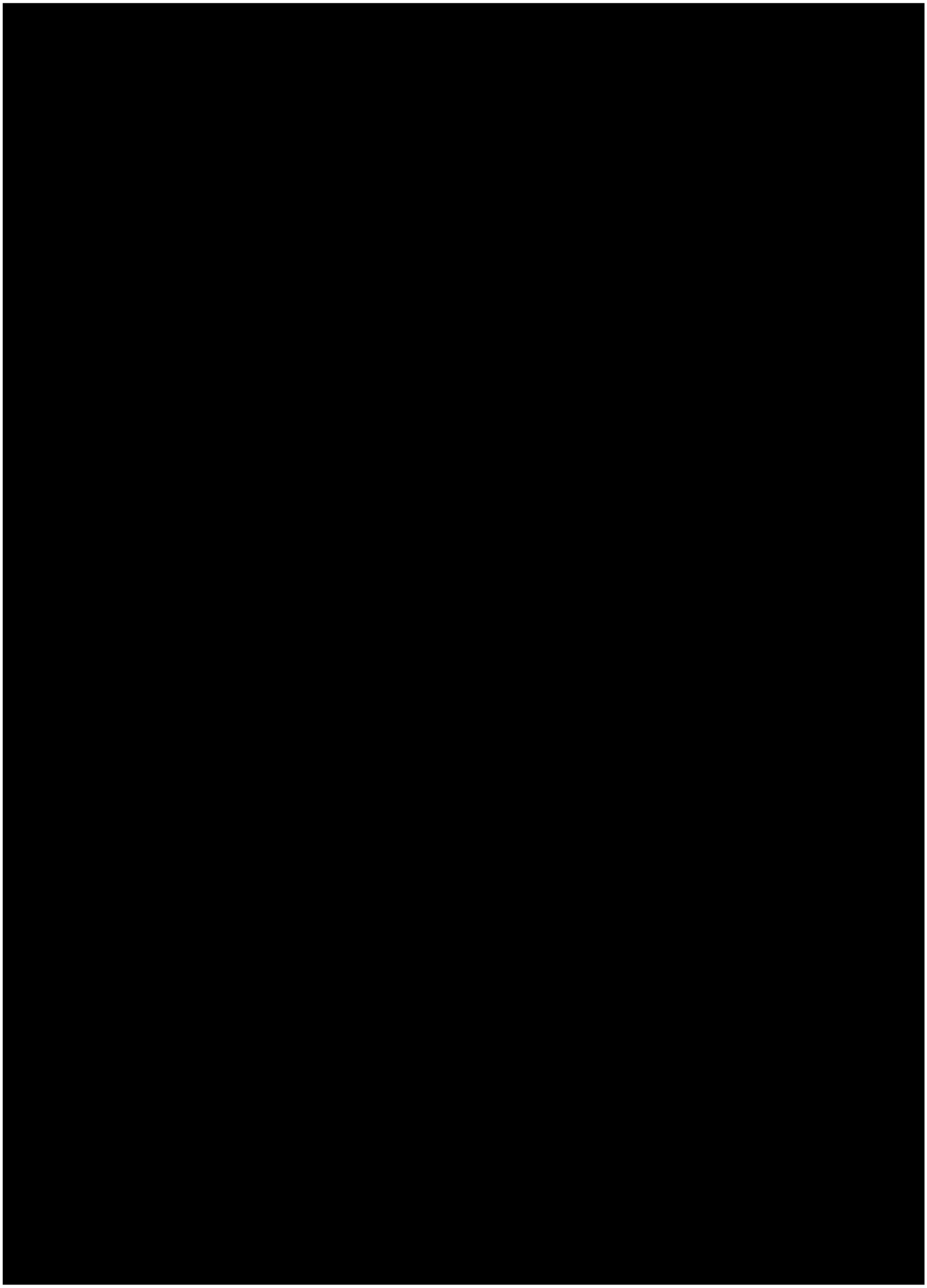
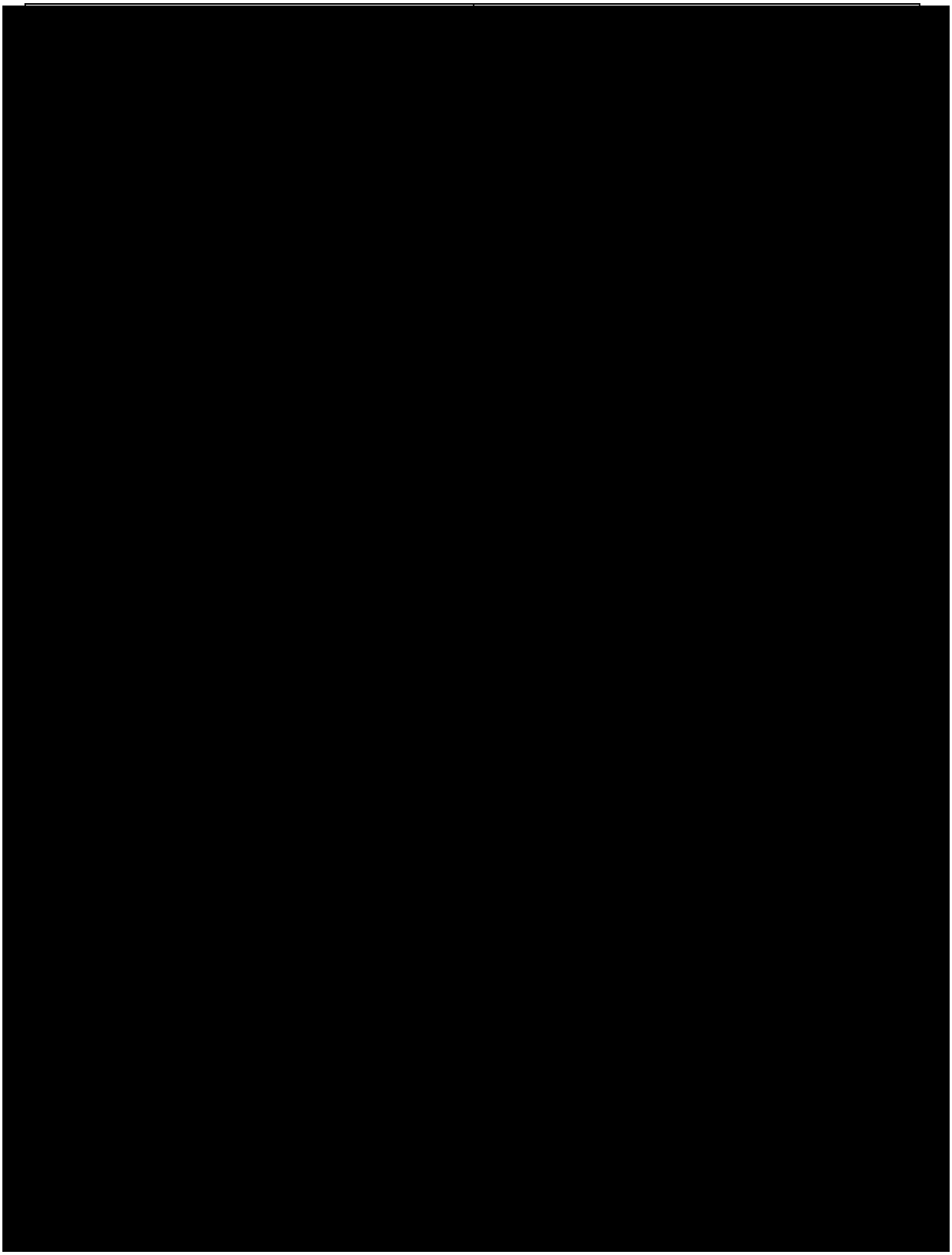
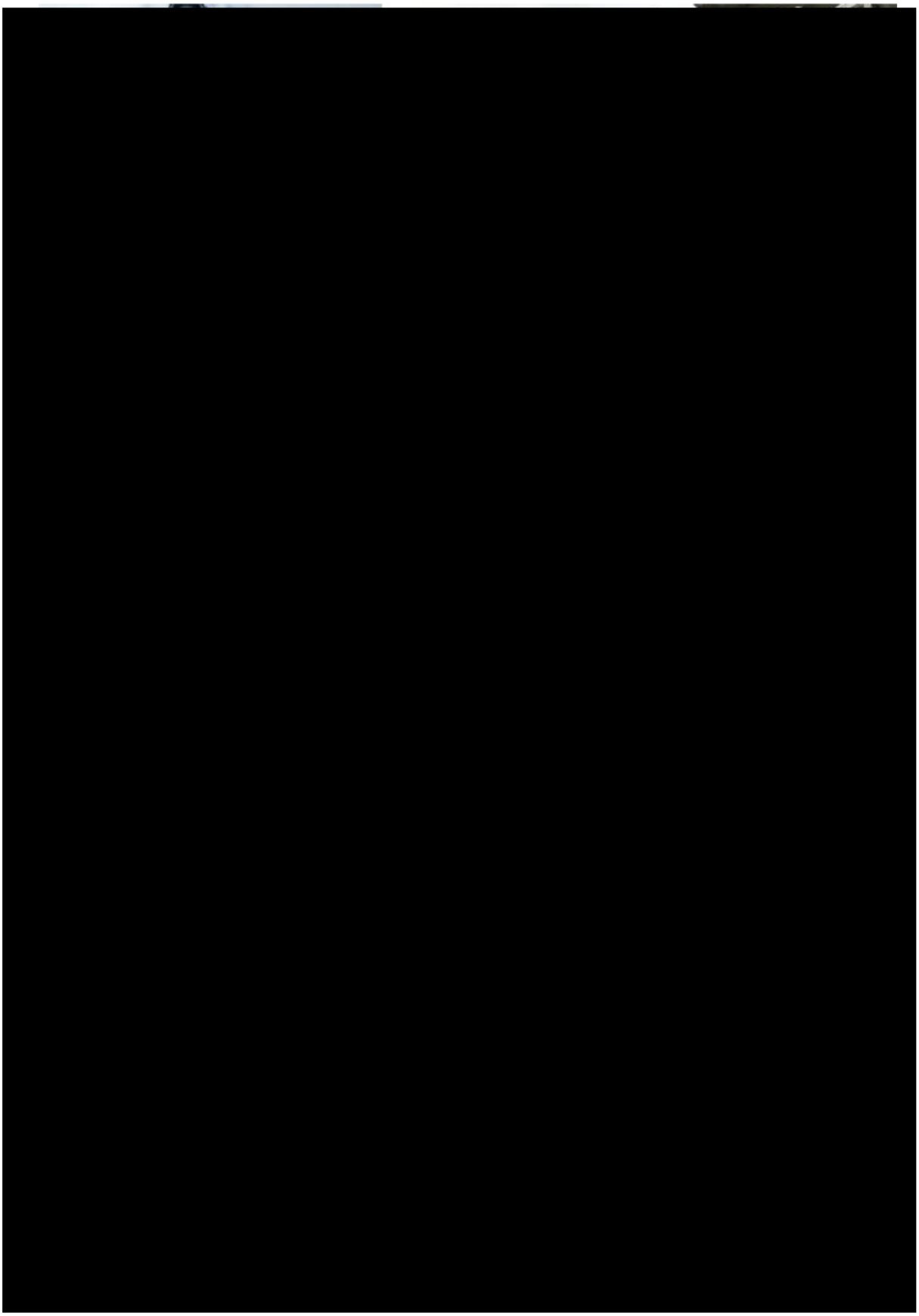
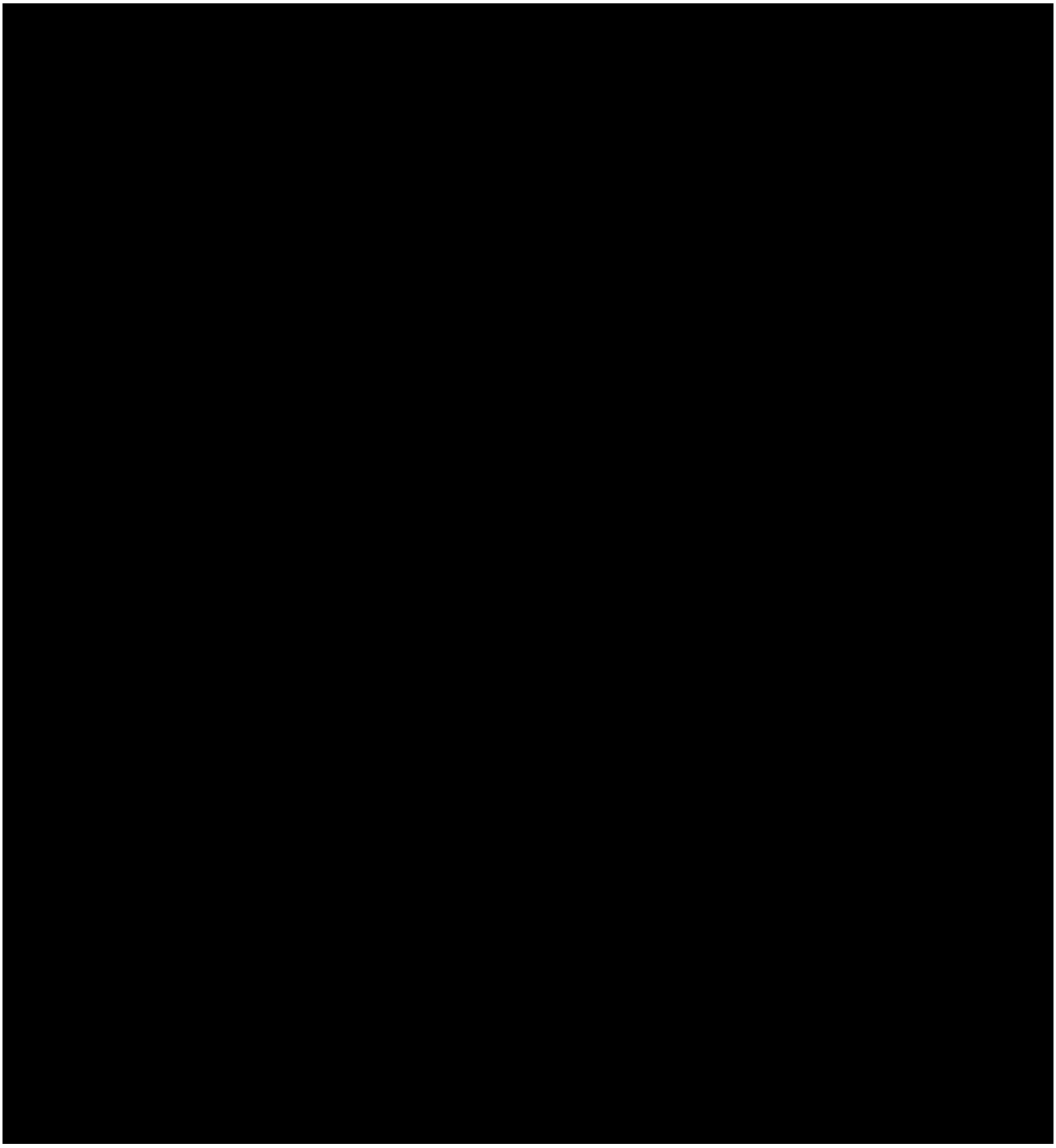
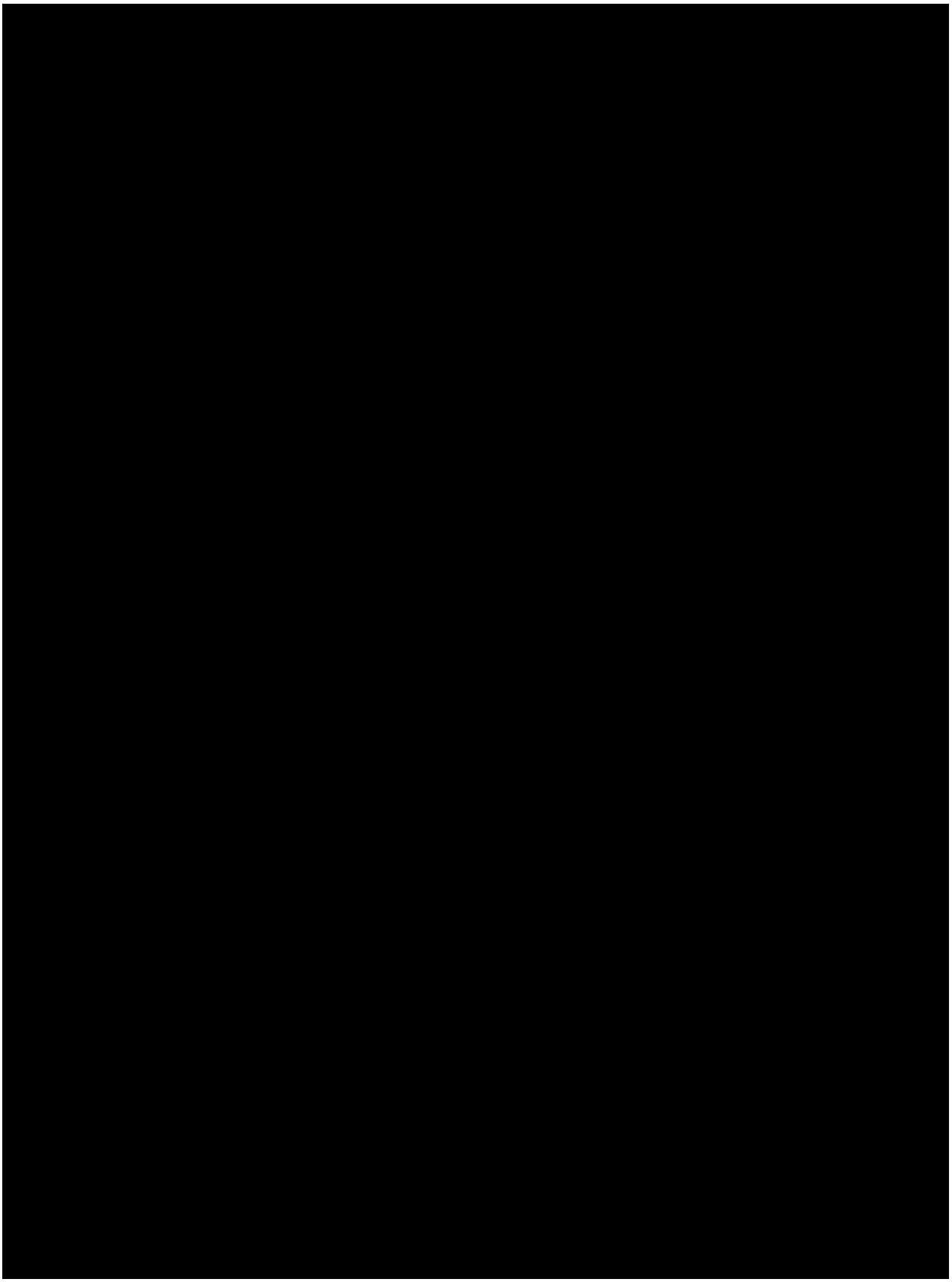
[3] Note, the gangway pedestal is distinct from the vessel pedestal for the gangway which is described in Section 2.3.2







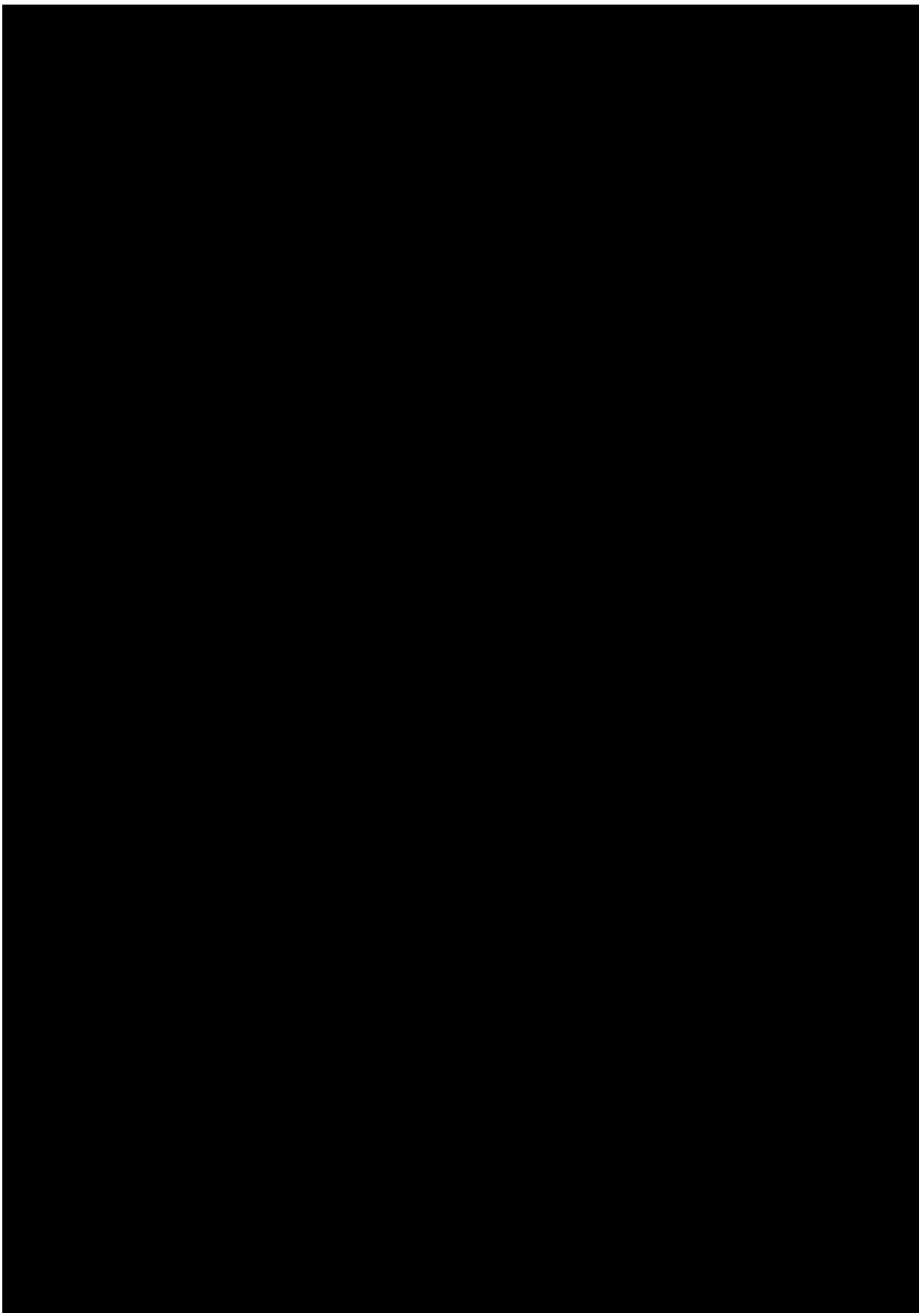


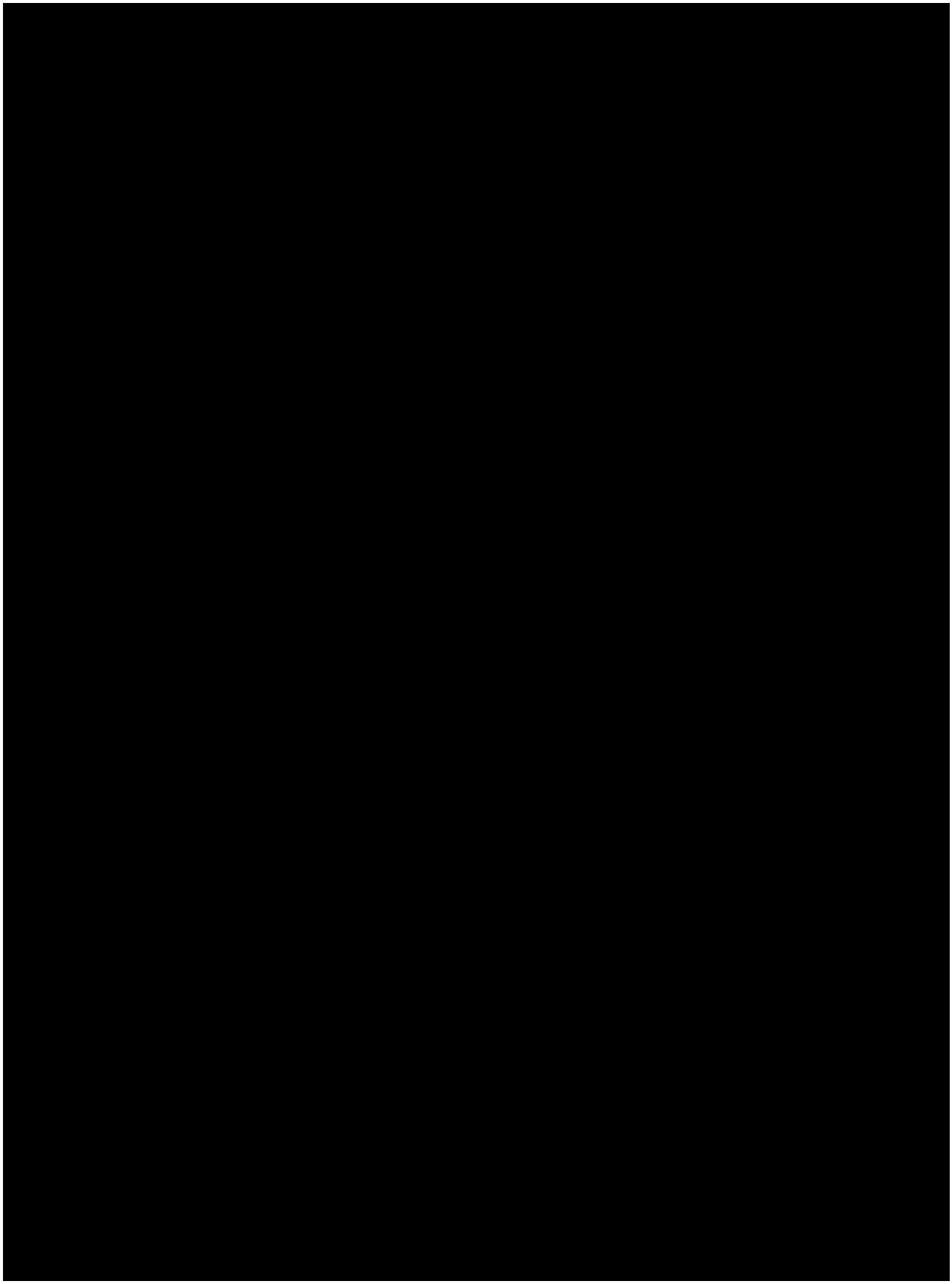


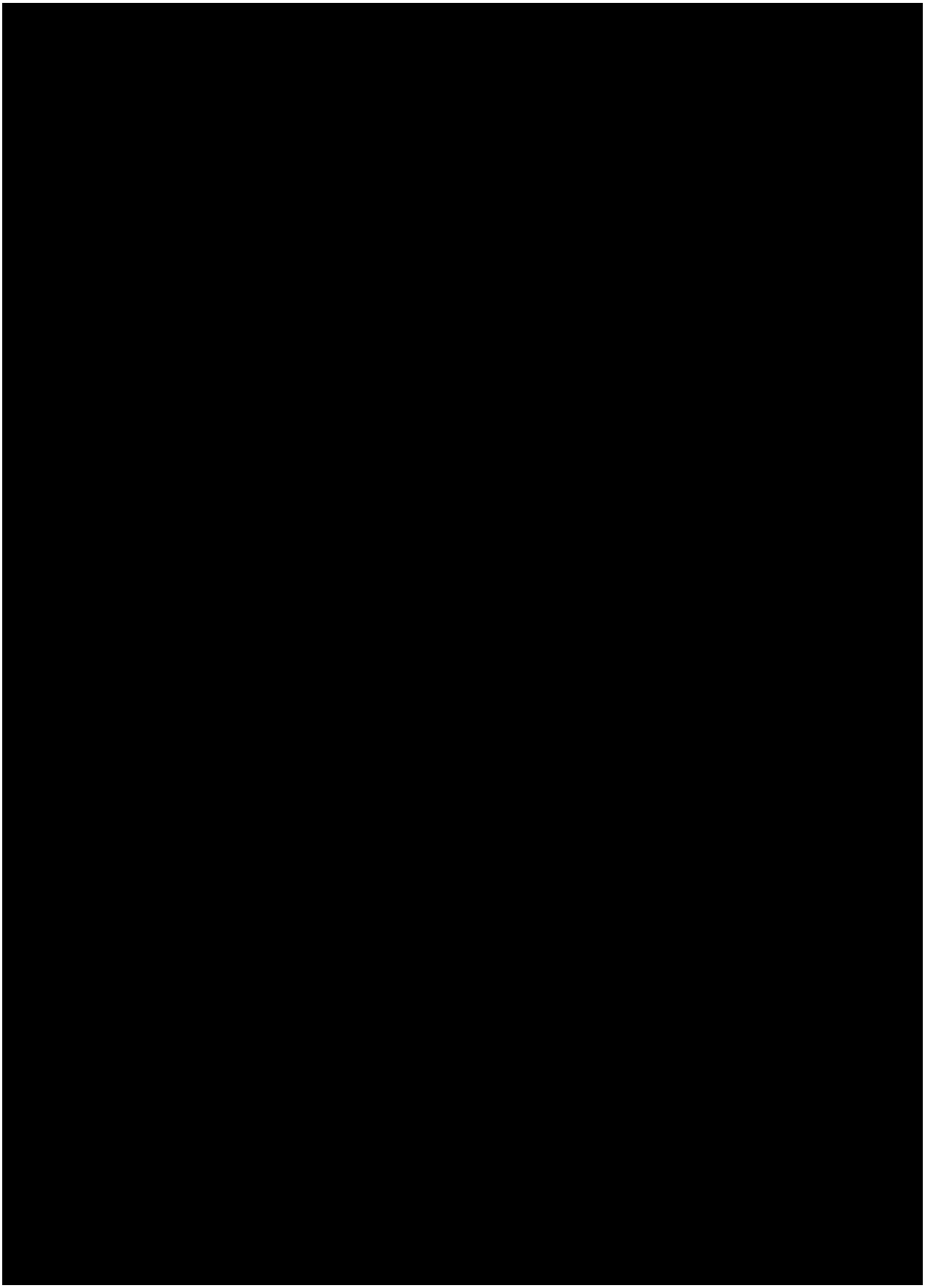
2.3.3.3 Design Standards

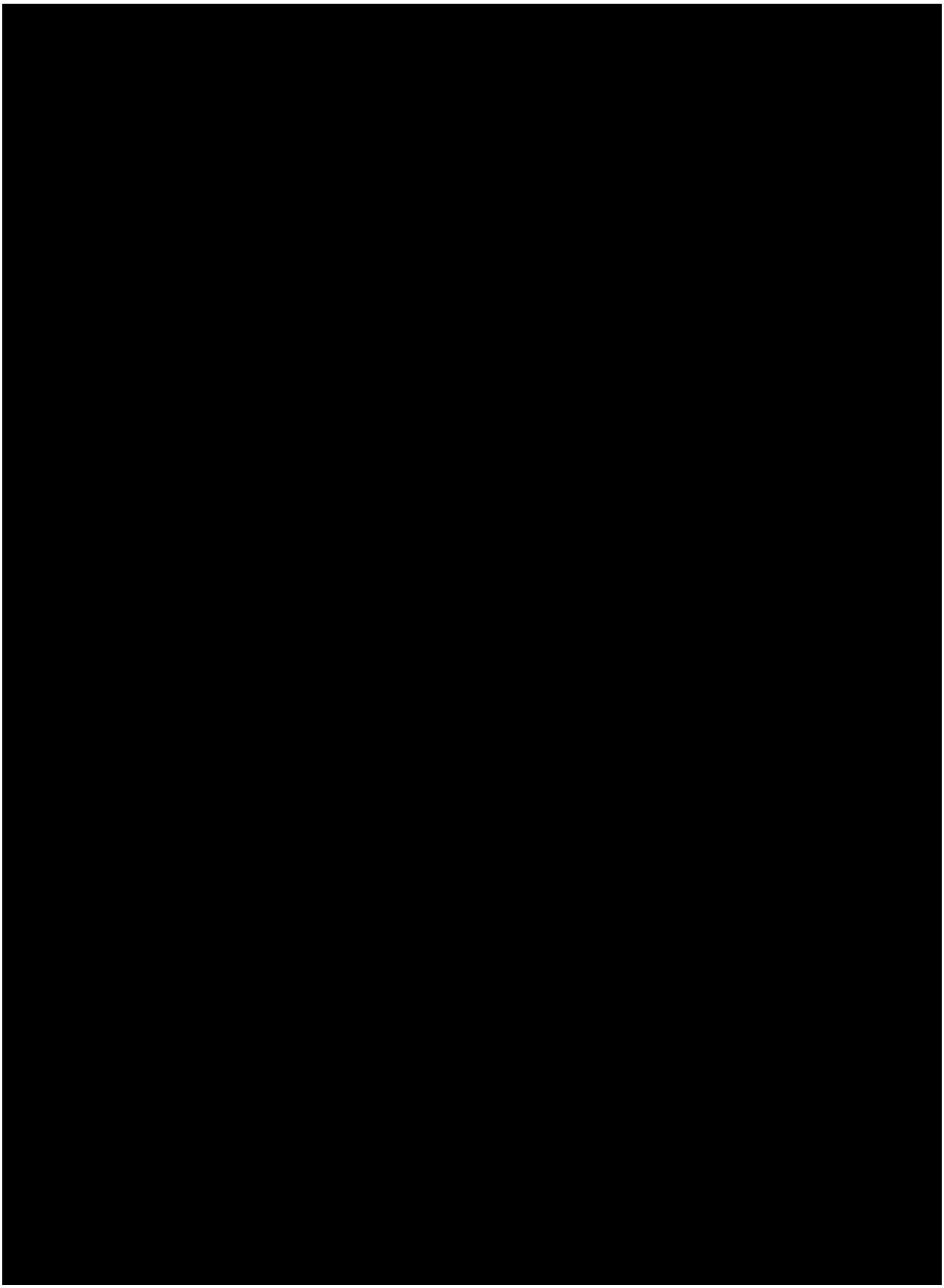
The gangway is designed and certified by Bureau Veritas (BV) in accordance with:

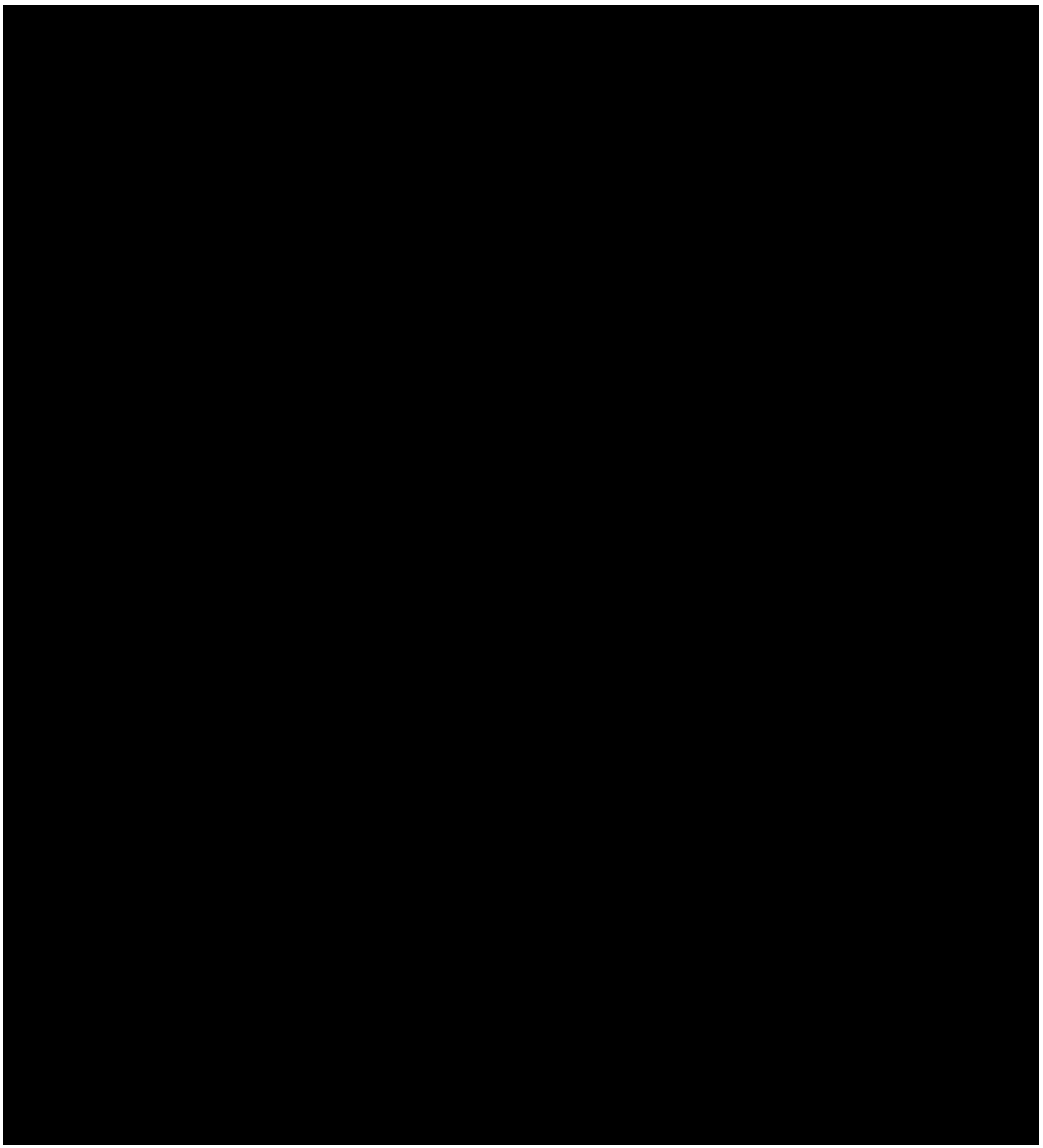
- Bureau Veritas, Certification of Offshore Access Systems, May 2016, NI 629 DT R00 E [18], herein referred to as BV OAS.

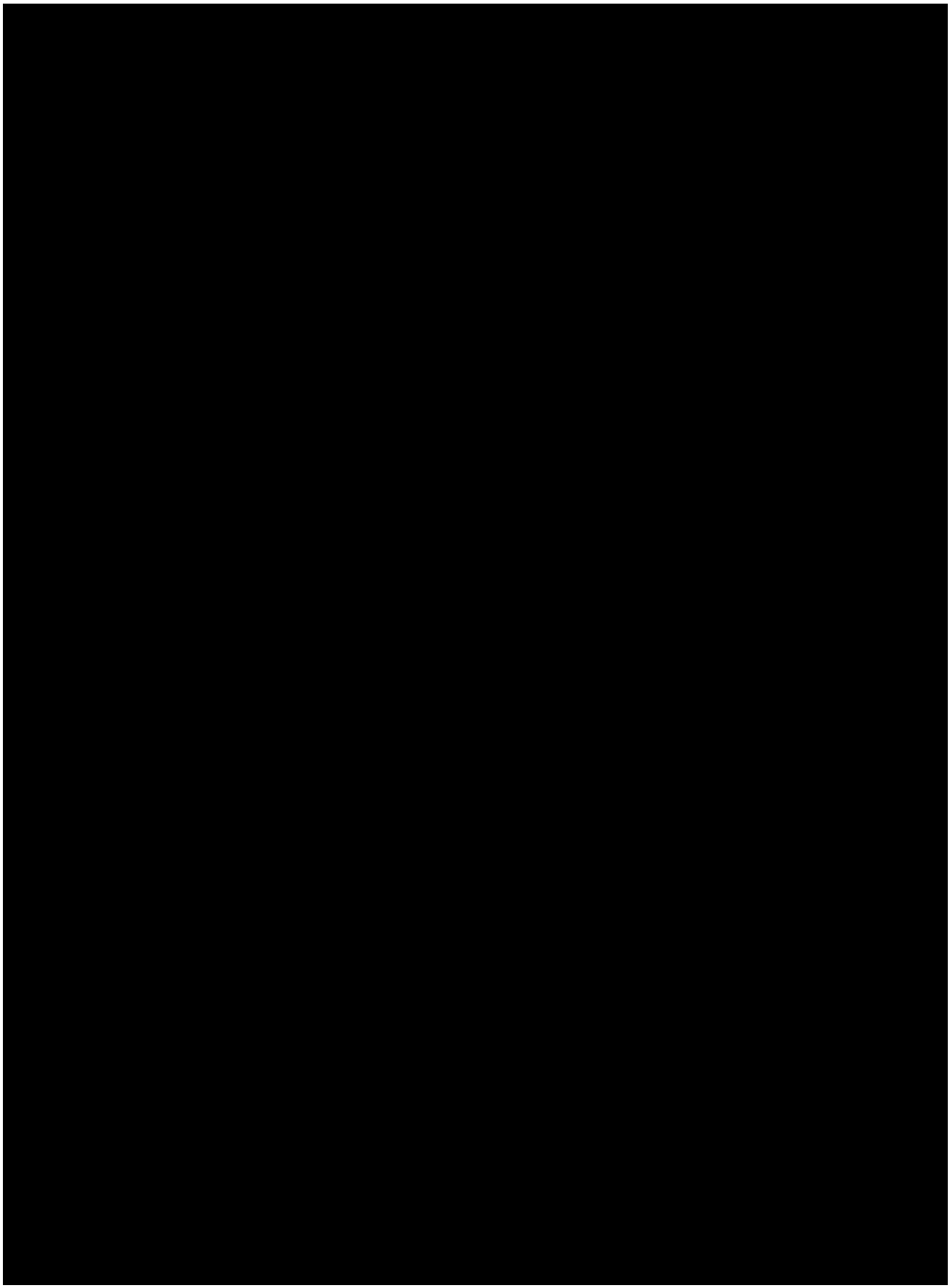


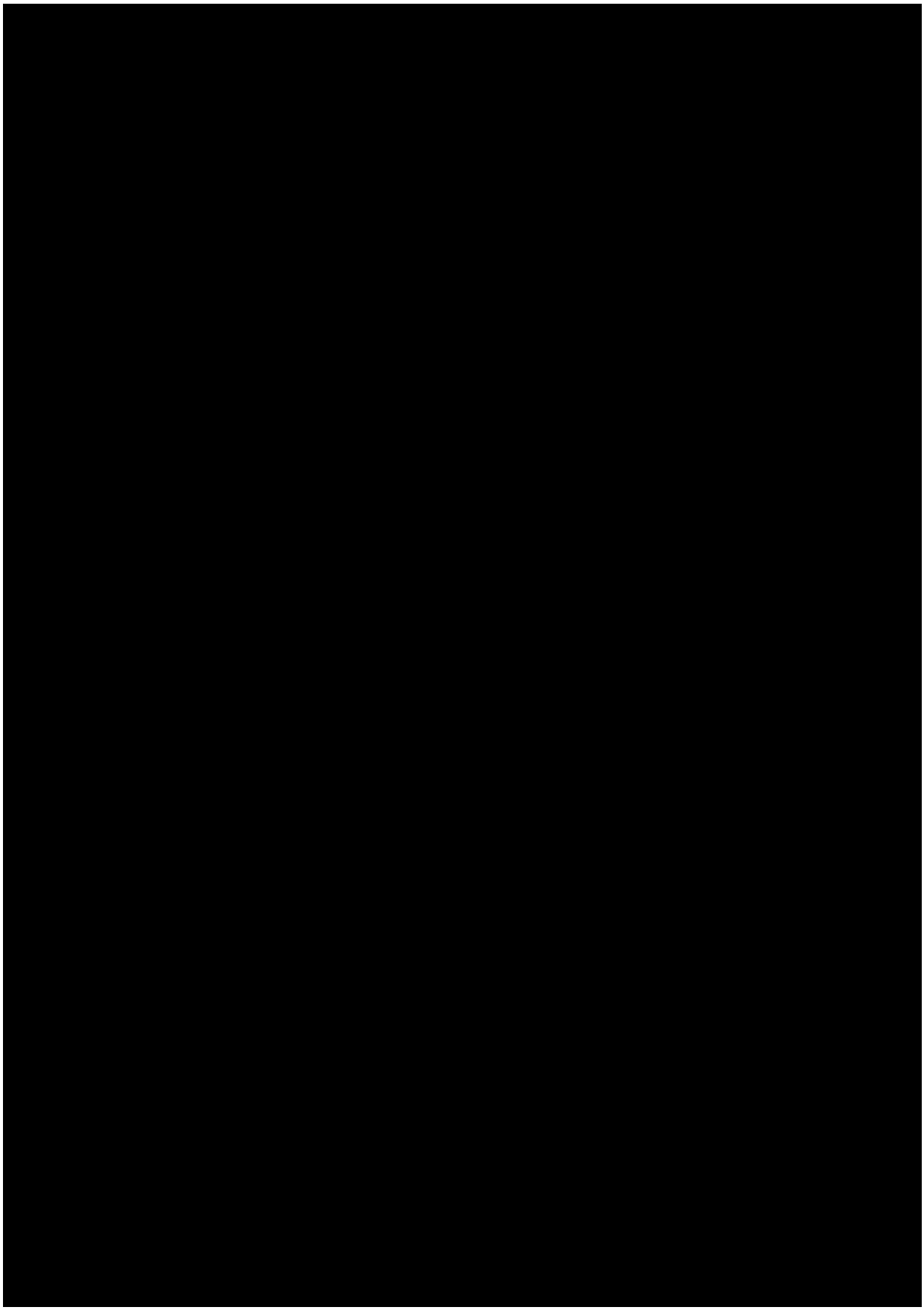


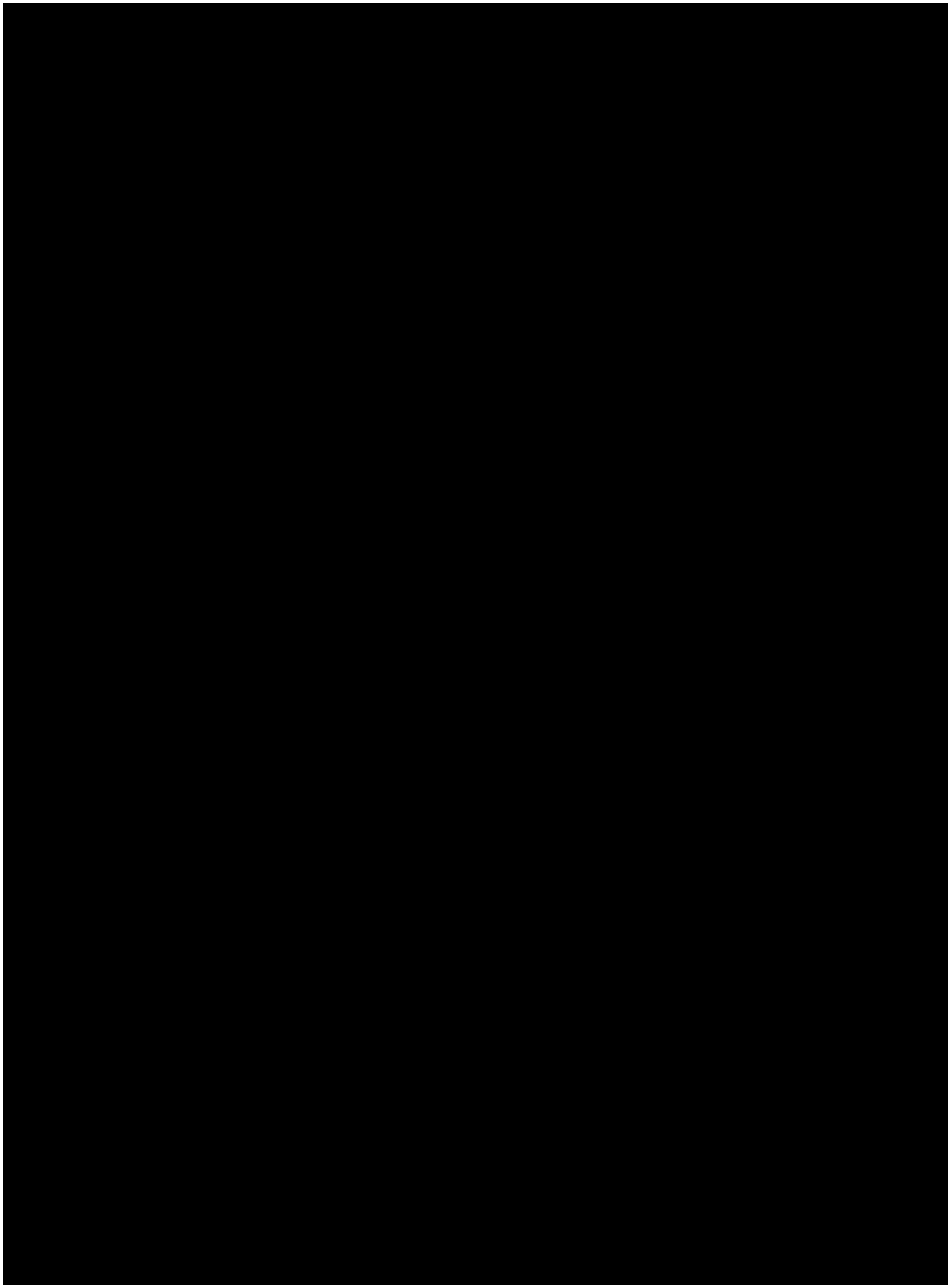


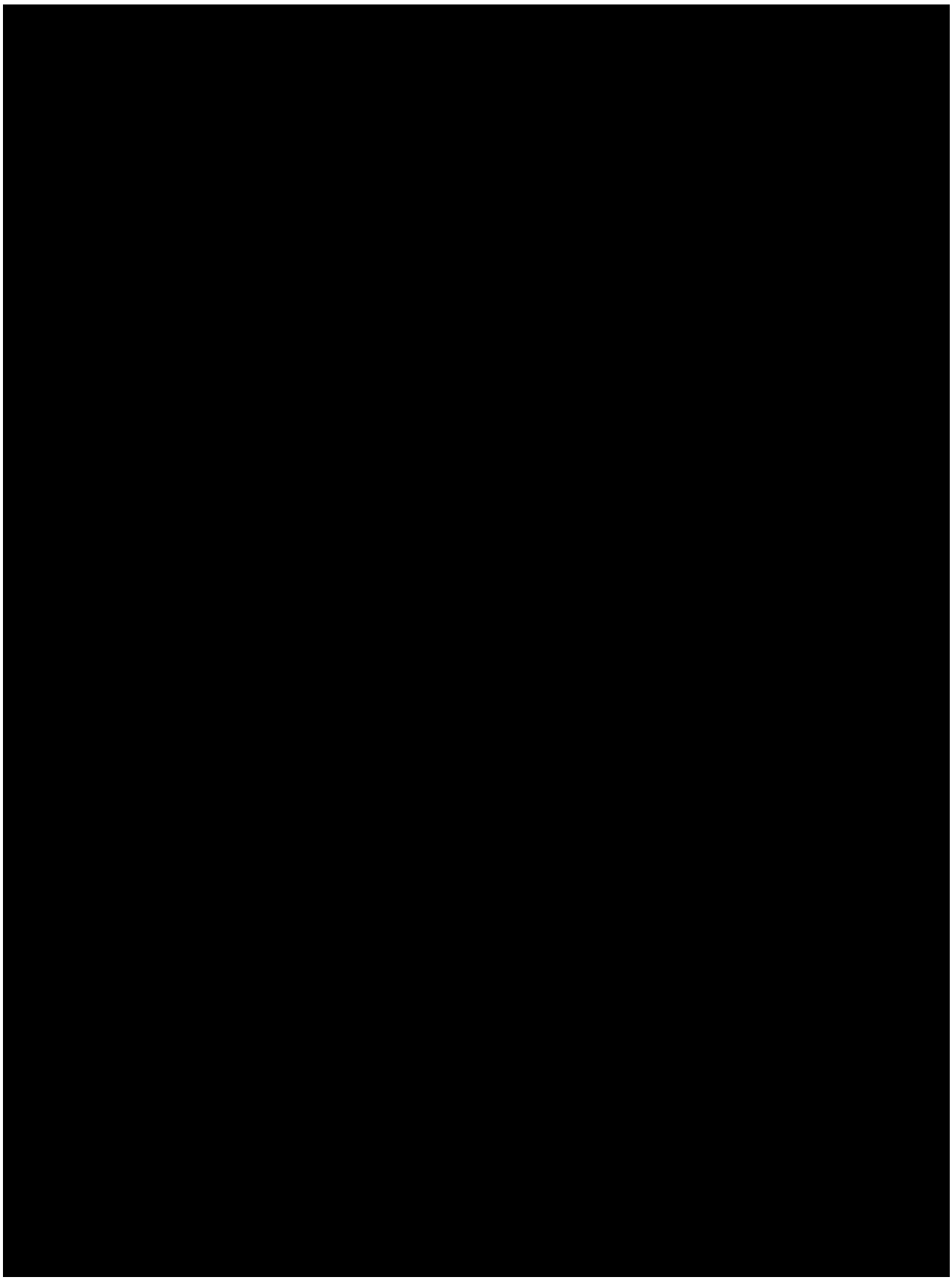


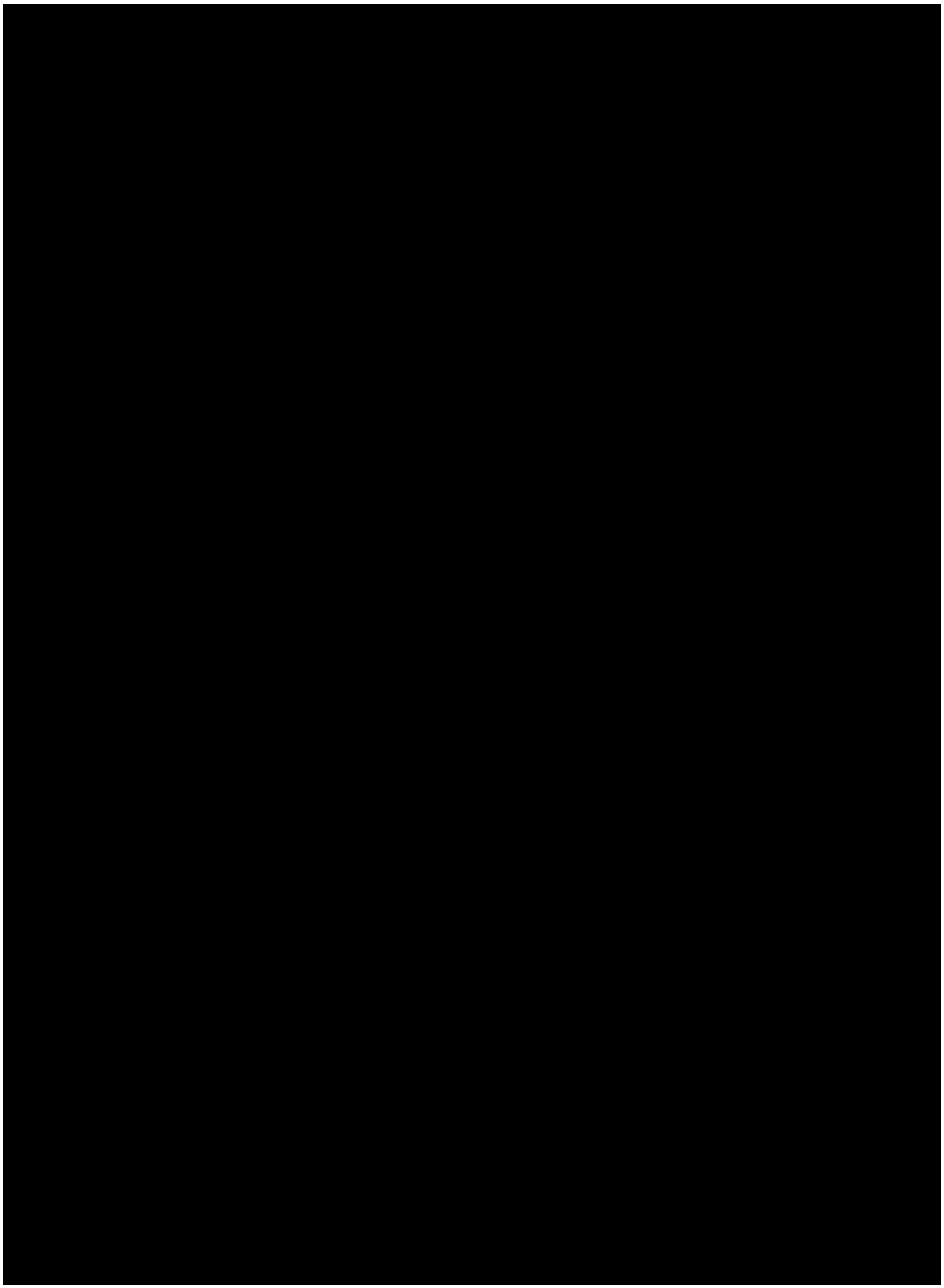












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Emergency lighting: Essential LED lighting in the gangway boom and control cabin is provided with battery back-up (UPS), hence will remain illuminated for approximately 15 minutes in the event of loss of all power supply to the gangway system.

Markings: The gangway walkways are clearly marked to highlight hazards associated with moving parts (i.e. where the inner to outer boom telescopes), changes in elevation, slewing hazard sector on the waiting platform and roll motion hazards at lower levels.

Hydraulic safety systems: The hydraulic components of the gangway are provided with a range of good practice safety features, including:

- Overpressure relief on the hydraulic systems, to prevent overloading
- Load holding valves on hydraulic cylinders, to prevent uncontrolled movement in case of hose / connection failure
- Whip restraint on applicable hydraulic hoses
- Redundancy of hoses and actuators on critical aspects of the system (e.g. spare pump set in HPU, double hoses, redundancy of servo blocks)
- System has been subject to FMEA to demonstrate adequate redundancy by design

2.4 [redacted]

[redacted]

2.5 [redacted]

[redacted]

[redacted]

3. SAFETY MANAGEMENT SYSTEM DESCRIPTION

This section of the SCR describes the safety management system implemented by Subsea 7 and MMA for vessel operations on the WTW Project.

The management system, which is described in part 3 of the Base Safety Case, Safety Management System Description (SMS), applies to MMA Pinnacle operations on the WTW Project. However, there are certain aspects which have required additional processes to be implemented to reduce risk to ALARP. The SCR is focused on the description of these additional processes, which are identified within Table 7, based on a gap assessment in relation to the Base Safety Case SMS.

The implementation of the Subsea 7 and MMA management systems on the project is communicated within the project HSE management plans, as described in Section 3.1.

Table 7: Base Safety Case SMS Bridging Table

Topic	Status	SCR Reference
Leadership and Policy	The overall organisational structure outlined in Base Safety Case SMS Section 3 remains applicable. The Gangway Operator is part of project personnel, hence reports to the Offshore Manager, in the same manner as other project supervisors. The additional WTW Personnel fall under the leadership of the Company Site Representative on board.	
Training and Competency	Additional training and familiarisation is described with respect to gangway operations. Training / competency requirements for Woodside WTW Personnel are also described, since they do not clearly fall under the existing MMA and Subsea 7 arrangements described in the Base Safety Case SMS.	Section 3.2
Workforce Involvement and Communication	No change	
Risk Management	No change	
Project Planning and Operational Procedures	No change to process and requirements, however, for completeness, the following are described: ▪ The project specific safety related management plans that have been developed to communicate Subsea 7 BMS implementation (refer Base Safety Case SMS Section 7.6) ▪ The field entry and vessel / platform SIMOPS management framework (refer Base Safety Case SMS Section 7.5)	Section 3.1 Section 3.6
Vessel Operating Procedures	Additional gangway operating procedures apply and are described.	Section 3.3
Occupational Health Management	Base Safety Case SMS details requirements that apply to MMA marine and Subsea 7 project crew on board. However, WTW Personnel are considered client personnel, hence the requirements that apply are described.	Section 3.5
Inspection, Maintenance and Assurance of Vessel and Equipment	Additional project specific requirements apply to inspection, maintenance and assurance of the gangway.	Section 3.4
Subcontractor Management	No change	
Emergency Preparedness and Response	Additional emergency response arrangements apply due to the incorporation of gangway operations.	Section 3.7
Monitoring Systems	No change	

Incident Reporting and Investigation	No change	
Audit and Review	No change	
Information Management and Document Control	No change	

3.1 PROJECT SAFETY RELATED MANAGEMENT PLANS

The following project plans will be in place for the WTW Project to satisfy contract and BMS requirements:

- Project Health, Safety, Security and Environment Management Plan (HSSEMP)
- Project Emergency Response Plan (ERP)

The Base Safety Case SMS Sections 7.6 and 12.2.2 already describe minimum requirements in terms of development of project specific documents to cover the above, to reduce risk to ALARP. However, a brief description of these documents is provided below for completeness.

3.1.1 Project HSSEMP

A project HSSEMP will be in place for the WTW Project, which will be subject to acceptance by the Operator, MMA and Woodside. It is intended to communicate to stakeholders the specific arrangements for safety management system implementation on the project, in accordance with the Subsea 7 and MMA requirements detailed in the Base Safety Case SMS. It also establishes how the Facility complies with any additional Woodside requirements (e.g. incident notification).

The HSSEMP encompasses the following subject matter:

- Management system overview
- Objectives and targets
- Leadership, responsibility and accountability
- Training and competency
- Health, Safety, Security and Environment (HSSE) consultation and communication
- HSSE risk management
- Contract and supplier management
- Management of interfaces
- Management of change
- PTW
- Emergency preparedness and response
- HSSE monitoring, measurement, and reporting
- Incident reporting and investigation, including notification requirements to Woodside
- HSSE audit and inspections
- HSSE hazard management (operational aspects)
- Fitness for work
- Security
- Environment management aspects

3.1.2 Project Emergency Response Plan

The project Emergency Response Plan (ERP) will be in place in accordance with the requirements of Base Safety Case SMS Section 12.2.2. The content of the ERP includes the following pertinent subject matter:

- Roles and responsibilities
- Project emergency response arrangements
- Offshore emergency response overview
- Specific emergency contingencies and arrangements for medevac at the project site
- Emergency drills schedule
- Security
- Injury management

With respect to emergency medevac from the offshore site, the arrangements will be as per the Pluto Riser Platform: Emergency Response Plan [19], which comprises helicopter medevac, which is a 45 minute each way flight from Karratha, followed by a jet flight from Karratha to Perth, which is a duration of approximately 1 hour and 41 minutes. Notification times and hospital transfers are detailed further in the ERP.

3.2 TRAINING AND COMPETENCY

Training and competency management for the vessel is detailed within Base Safety Case SMS Section 4. However, additional WTW Project training and familiarisation requirements are detailed below, in relation to the following:

- Vessel crew – Section 3.2.1
- Gangway operators – Section 3.2.2
- WTW Personnel – Section 3.2.3
- Descent device training – Section 3.2.4

3.2.1 Vessel Crew

Marine crew training and competency is as per Base Safety Case SMS Section 4. However, it is recognised that marine crew familiarisation with the gangway system is important for safe and integrated vessel and gangway operations. This is achieved through onboard familiarisation during mobilisation, system trials, participation in kick-off processes, drills, and the range of workforce communication and risk management practices in place.

3.2.2 [redacted]

[redacted]

- [redacted]

[redacted]

[redacted]

[redacted]

3.2.3 WTW Personnel

The WTW Personnel on board the vessel are considered part of the vessel's permitted complement of 'special personnel' under Code of Safety for Special Purpose Ships (SPS Code) [20], hence are not subject to the same International Convention for the Safety Of Life At Sea (SOLAS) and Standards of Training, Certification and Watchkeeping for Seafarers (STCW) requirements as the vessel's crew. The WTW Personnel are also client personnel, on board for the purposes of working on another Facility. As such, the level of training and competency for WTW Personnel is driven by the following:

- SPS Code requirements for 'special personnel'
- Client training and competency requirements, as detailed in the Pluto Safety Case [4]
- Project specific requirements (e.g. descent device training)

The training requirements for all WTW Personnel, as far as being on the vessel, include the following:

- Must hold a valid Offshore Petroleum Industry Training Organization (OPITO) approved Tropical Basic Offshore Safety Induction and Emergency Training (TBOSIET) certificate (which includes Helicopter Underwater Escape Training (HUET))
- Must receive a vessel induction as soon as practicable upon boarding the vessel, such that they are familiar with the arrangement of the vessel, its safety systems, workforce communication arrangements, housekeeping matters, and risk management practices (refer to Base Safety Case SMS Section 4.6.2)
- Must receive a project induction, as per Base Safety Case SMS Section 4.6.3
- Must receive vessel safety case awareness training, as per Base Safety Case SMS Section 4.7
- Must receive descent device training (refer to Section 3.2.4)

Training / induction validity and verification is undertaken by the vessel's clerk / administrator, prior to each person boarding the vessel either in port or via helicopter.

All personnel required to use the gangway to access the host-platform are provided with a gangway induction and a gangway safety information card, which details the following:

- General instructions for crossing
- General safety precautions (i.e. mandatory Personal Protective Equipment (PPE), use of handrails, awareness of moving parts, permitted personal items, Banksman in charge)
- Crossing procedure (including the stop / go light system rules)
- Emergency retrieval system alarms / indication and required course of action based on where the individual is at the time (i.e. on waiting platform, boom tip, outer boom, inner boom, slewing platform)

3.2.4 Descent Device Training

The Gangway Operator and the Banksman shall be formally assessed as competent in the use of the Rollgliss emergency descent devices in accordance with the device specific competency assessment report. This assessment comprises both a theoretical equipment knowledge assessment and practical exercises in use of the device, guided by an approved trainer / assessor.

All WTW Personnel must also be familiarised with the Rollgliss devices by a competent person. This familiarisation will be provided by means of practical demonstration and familiarisation at deck level once they are on board the vessel. No WTW Personnel will be permitted to use the gangway unless they have completed descent device familiarisation.

WTW Personnel also hold BOSIET / TBOSIET qualifications, hence have been trained in practical use of similar equipment (i.e. fitting a strop and body position during descent, albeit in the context of helicopter winching).

It is noted that use of a descent device is very unlikely and is only intended for a situation whereby there has been major damage or failure of the gangway upper part lifting mechanism.

3.3 GANGWAY OPERATING PROCEDURES

Robust procedures have been put in place to ensure all risks associated with offshore gangway operations are reduced to a level that is ALARP. A description of the pertinent processes is described below in relation to the following:

- Gangway manuals
- Walk to work procedures
- Operability management
- Gangway landing location selection (on the host-platform)
- Vessel positioning
- PTW (vessel)

3.3.1 [redacted]

[redacted]

3.3.2 Walk To Work Procedures

WTW procedures and task plans shall be developed for the WTW Project. The procedures developed address the following considerations in relation to the project:

- Adverse weather criteria
- Communications protocols (planned and emergency)
- Offshore facility approach and vessel positioning (refer to Section 2.2.3 and Section 3.3.5)
- Reference to applicable HSSEMP (refer to Section 3.1.1)
- SIMOPS management protocols that apply (refer to Section 3.6)
- Collision avoidance management
- Actions in the event of degradation of critical equipment
- Transfer management / personnel tracking
- Gangway deployment procedures
- Gangway connection mode required on the project
- Gangway transfer policy
- Gangway emergency procedures / actions
- PPE, including the requirement for a Personal Locator Beacon (PLB) during transfer
- Clear deck policy that applies during gangway operations

3.3.3 Operability Management

Gangway operations are only undertaken when the environmental conditions permit, and where approved by the vessel Master, the Offshore Manager (OM) and the host-facility person in charge.

It is recognised that establishing clear weather limitations is important for aiding operability decisions. As such, in accordance with DNVGL WTW Guidance, the

workability of the gangway has been established through dynamic analysis, as detailed in Section 2.3.3.4.

The operability of the system is incorporated into operational procedures and task plans, in accordance with the principles outlined in SMS Section 7.2.

For the WTW Project, the vessel will also adhere to a WTW specific ASOG, in the same manner as that described in SMS Section 8.15. This ensures that suitable operating boundaries are also established for the integrated DP operations.

During gangway operations, it is the responsibility of the Gangway Operator to ensure that the system is operated within its designed limits. However, this aspect is aided by the range of hardware systems in place to monitor conditions and indicate when conditions deteriorate. These hardware systems are described in Section 2.3.3.

3.3.4 Gangway Landing Location Selection

A selection of gangway landing locations on the host-facility have been defined, as detailed in Section 2.1.5. Each landing location is designed by the host-facility operator and agreed with the vessel prior to commencing operations. The locations are selected and agreed based on a wide range of factors applicable to the vessel, in accordance with DNVGL WTW Guidance, to ensure:

- Adequate structural capacity for any imposed planned and accidental loads
- Clearance of process related hazards (risers, conductors, pipelines, umbilical etc)
- Compatibility with the gangway position on the vessel (mainly due to the position the vessel needs to assume to position the gangway, and associated location of other vessel protrusions (vessel mast, helideck) in relation to the platform
- Separation from dropped object zones where practicable
- Selected location increases / optimises the ability of the vessel to orientate to the prevailing environmental conditions
- Adequate lighting is available
- Sufficient clearances to accommodate the geometry of the gangway, including overhead clearances to account for luffing associated with emergency retrieval systems
- Adequate handrailing / embarkation arrangements at the landing location
- Outside of hazardous zones / areas on the host-facility

Further information regarding vessel positioning is provided in Section 2.1.5. Further information regarding PLA related aspects of landing site selection, design and overall suitability are provided in the Pluto Safety Case.

3.3.5 [redacted]

[redacted]

- [redacted]
- [redacted]

[redacted]

[redacted]

3.3.6 Permit To Work

Gangway operations are undertaken under a vessel Permit To Work (PTW). This is in accordance with Base Safety Case SMS Section 6.8, which stipulates that personnel transfer falls under the PTW system.

3.4 GANGWAY MAINTENANCE AND ASSURANCE

3.4.1 Gangway System Assurance

Assurance regarding the gangway system equipment is achieved through the following:

- Ensuring the gangway design and construction is independently certified in accordance with appropriate industry standards
- Ensuring the gangway foundation / pedestal design and construction is independently certified in accordance with appropriate industry standards
- Inspection and NDE as part of the installation verification and certification process
- Ensuring the gangway has been demonstrated to have adequate redundancy based on an FMEA
- Ensuring a robust and appropriate inspection and maintenance routine is in place and adhered to
- Ensuring the system is operated only by trained and competent personnel
- Ensuring the system is subject to an ITP prior to acceptance for operations on the project
- Ensuring drills are undertaken during operations to demonstrate emergency system performance

3.4.2 Inspection, Maintenance and Testing

Gangway maintenance is achieved using a 3-tier system, comprising:

1. On board maintenance routines performed by the Gangway Operator and Banksman, both in port and offshore
2. Periodic maintenance performed with the assistance of specialist maintenance personnel
3. Periodic system overhaul

The requirements associated with the tier 1 routines are covered by the Gangway Operator training program, and sufficient spares and consumables are maintained on

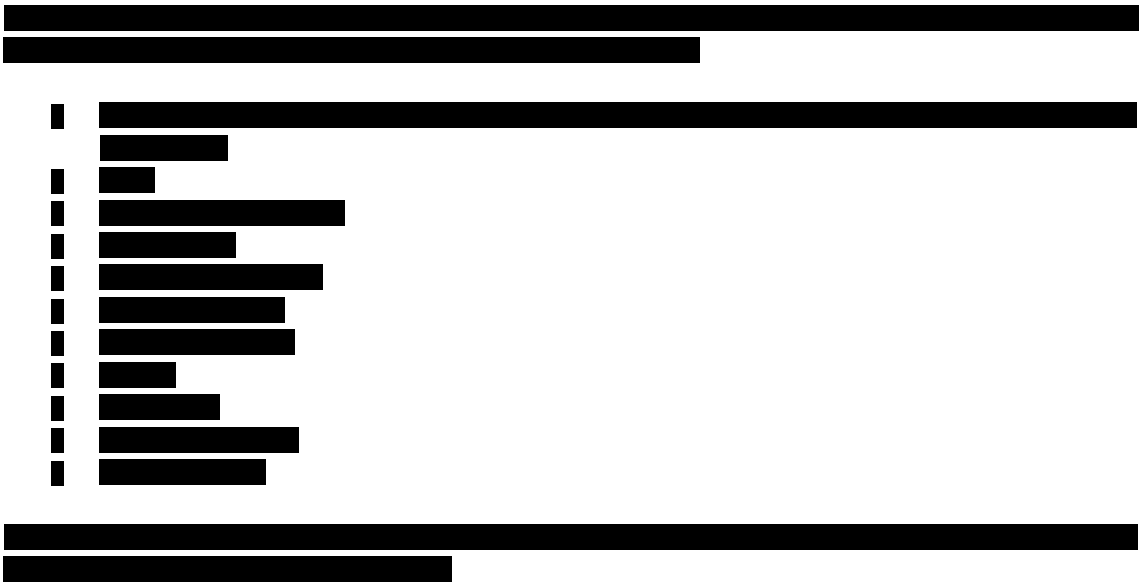
board to execute the necessary tasks. Instructions for these tasks are also provided in the gangway instruction manual [16]. A remote maintenance service desk is provided by Safeway onshore to assist offshore maintenance as required.

Tier 2 tasks include specialist maintenance and non-planned maintenance. Execution of these tasks requires attention of specialist technicians, who are mobilised offshore / to port as required.

Tier 3 overhaul activities ensure that parts subject to wear are changed out, normally on a 5-yearly basis. This tier is intended to take the system back to an as new state.

The gangway is designed to receive a remote network connection for system diagnostics purposes. However, such a connection may only be made if authorised by the Gangway Operator and the onshore maintenance service desk.

The status of gangway maintenance is verified during mobilisation activities, as part of the ITP.



3.5 WTW PERSONNEL OCCUPATIONAL HEALTH MANAGEMENT

A number of Woodside employees and contractors will be on board during the WTW Project, referred to in the SCR as WTW Personnel. WTW Personnel, although the responsibility of the vessel whilst on board, are subject to equivalent Woodside standards with respect to certain occupational health matters, as follows:

- Shall comply with Woodside's fitness for work standards
- Hold a valid Woodside approved medical
- Adhere to Woodside fatigue management policies

The above requirements are aligned with the level of control in place with respect to marine and project personnel, hence considered appropriate. In all cases, it provides for an equivalent or greater level of control in comparison to Subsea 7 and MMA requirements for project personnel detailed in Base Safety Case SMS Section 9.

3.6

- [redacted]

[redacted]

[redacted]

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- [redacted]

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[redacted]

[redacted]

[redacted]

4. FORMAL SAFETY ASSESSMENT DESCRIPTION

This part of the SCR presents the Formal Safety Assessment Description (FSA) in relation to vessel activities on the WTW Project.

4.1 INTRODUCTION

4.1.1 Objective

The objectives of this part of the SCR are to:

- Identify all WTW Project hazards that have the potential to cause a MAE, that are not covered by the Base Safety Case
- Present a detailed and systematic assessment of each additional MAE that applies on the WTW Project
- Identify and assess technical and other control measures that are required to reduce project MAE risk to ALARP

4.1.2 Scope

The FSA presented in this SCR reflects the scope of offshore vessel activities on the WTW Project, as outlined in Section 1.3.

4.1.3 Formal Safety Assessment Process

The vessel project activities were subject to a systematic FSA process, equivalent to that presented in Base Safety Case FSA Section 1.5, comprising:

- Hazard Identification and Risk Assessment (HIRA)
- MAE identification and assessment, including a MAE workshop, bowtie analysis, and SCE and SCP identification
- FSA studies, including:
  - Fire and Explosion Analysis (FEA)
  - Non-Flammable Hazard Assessment (NFHA)
  - Escape, Evacuation, and Rescue Analysis (EERA)
  - Emergency System Survivability Analysis (ESSA)
  - ALARP demonstration

In order to reduce the risk associated with each project MAE, emphasis during each phase of the FSA process was placed on the identification of additional risk reduction measures (i.e. in addition to those measures in place at the time of safety case development). Such risk reduction measures were added to the Recommendations Register (provided in Appendix G) and considered during the ALARP demonstration process (refer to Section 4.8). The FSA was then subsequently updated to reflect the additional risk reduction measures implemented, as part of what was a cycle of control measure identification, ALARP review, and risk assessment.

Further information regarding each phase of the FSA process is provided subsequently in this document, and also in the associated parts of the Base Safety Case, which are referenced within this SCR FSA.

4.1.4 Workforce and Stakeholder Participation

Workforce and stakeholder participation was utilised during development of the SCR to:

- Obtain engagement and participation of workforce
- To engage with the field operator

The involvement occurred throughout the development process, the majority of which was formally recorded by way of participation or attendance registers.

The participants had significant experience in operation of the vessel, gangway operations, the relevant aspects of the host-facility, and the relevant management systems. Subsea 7 is therefore satisfied that an adequate level of involvement and participation has been achieved.

A summary of workforce and stakeholder participation is provided in Table 8. Attendance records are provided Appendix D.

Table 8: Workforce Participation Register

Name	Position	Company	HIRA/MAE/ALARP Workshop	Consultation and Review for RFWI
[redacted]			X	
			X	X
			X	X
			X	X
			X	X
			X	X
			X	X
			X	
			X	X
			X	
			X	
			X	X
			X	X
			X	X

4.2 HAZARD IDENTIFICATION

A Hazard Identification and Risk Assessment (HIRA) study was undertaken to identify the hazards and MAEs that apply to the vessel on the WTW Project. The objectives of the HIRA study were to:

- Develop a hazard register that encompasses additional hazards that apply to the vessel whilst operating on the project
- Risk rank each hazard in terms of the worst-case potential safety consequence (regardless of probability of occurrence and control measures)
- Identify MAEs (refer to Section 4.3.1)

4.2.1 Methodology (HIRA)

The Base Safety Case hazard register was reviewed by a multi-disciplined team during a HIRA / MAE workshop against the WTW Project scope of work for the vessel. The participant selection ensured that the process was effective, and that it reflected up to date information for the vessel, gangway configuration and the host-facility of concern. Detailed information regarding the workshop is provided in the project specific workshop report [22].

With respect to HIRA, the workshop process involved the following steps:

- Review the pre-populated hazard registers
- Add any additional project hazards that apply
- For each new hazard, record the potential causes and consequences
- Qualitatively risk rank each new hazard in terms of worst-case potential safety severity (regardless of probability of occurrence or control measures), using the Subsea 7 Risk Analysis Matrix (Figure 31)

All workshop actions raised were closed out during safety case development, and recommendations were added to the Recommendations Register in Appendix G.

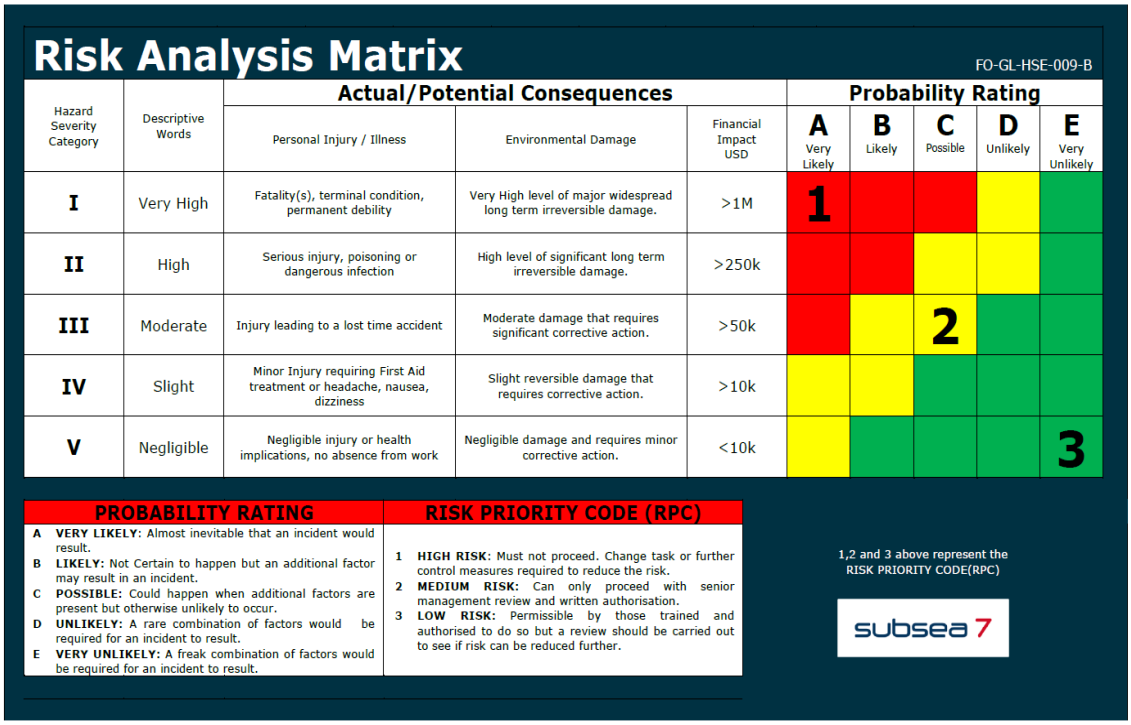
A summary of the additional hazards identified for the SCR is provided in Appendix E. All other hazards associated with Facility operations are as per the register provided in Base Safety Case FSA Appendix B.

4.2.2 Risk Ranking

A 'pre-controls' (or 'raw') risk ranking was assigned to each of the additional project hazards identified based on the Subsea 7 Risk Analysis Matrix as shown in Figure 31. However, to distinguish a MAE from a non-MAE, the severity ranking of Very High is split into the following:

- *'Very High – M'*: for multiple fatality
- '*Very High – S'*: for single fatality, terminal condition, and permanent disability

The 'pre-controls' risk ranking was limited to safety related consequences and was based on what attendees considered to be a reasonable worst-case consequence, regardless of the probability of occurrence, and before the consideration of control measures.



Risk Analysis Matrix FO-GL-HSE-009-B

Hazard Severity Category	Descriptive Words	Actual/Potential Consequences			Probability Rating				
		Personal Injury / Illness	Environmental Damage	Financial Impact USD	A Very Likely	B Likely	C Possible	D Unlikely	E Very Unlikely
I	Very High	Fatality(s), terminal condition, permanent debility	Very High level of major widespread long term irreversible damage.	>1M	1				
II	High	Serious injury, poisoning or dangerous infection	High level of significant long term irreversible damage.	>250k					
III	Moderate	Injury leading to a lost time accident	Moderate damage that requires significant corrective action.	>50k			2		
IV	Slight	Minor Injury requiring First Aid treatment or headache, nausea, dizziness	Slight reversible damage that requires corrective action.	>10k					
V	Negligible	Negligible injury or health implications, no absence from work	Negligible damage and requires minor corrective action.	<10k					3

PROBABILITY RATING

A **VERY LIKELY:** Almost inevitable that an incident would result.
B **LIKELY:** Not Certain to happen but an additional factor may result in an incident.
C **POSSIBLE:** Could happen when additional factors are present but otherwise unlikely to occur.
D **UNLIKELY:** A rare combination of factors would be required for an incident to result.
E **VERY UNLIKELY:** A freak combination of factors would be required for an incident to result.

RISK PRIORITY CODE (RPC)

1 **HIGH RISK:** Must not proceed. Change task or further control measures required to reduce the risk.
2 **MEDIUM RISK:** Can only proceed with senior management review and written authorisation.
3 **LOW RISK:** Permissible by those trained and authorised to do so but a review should be carried out to see if risk can be reduced further.

1,2 and 3 above represent the RISK PRIORITY CODE(RPC)

subsea 7

Figure 31: Risk Analysis Matrix

4.2.3 Outcome

The outcome of the SCR HIRA study for the project is contained with a hazard register, a summary of which is presented in Appendix E (Hazard Register Summary).

The information contained within the hazard register, and the methodology in terms of presenting control measures, is as per Base Safety Case FSA Section 2.3.

4.3 MAJOR ACCIDENT EVENTS AND SCE / SCP

4.3.1 Major Accident Events (MAE)

A MAE is defined as "an event, including a natural event, having the potential to cause multiple fatalities at or near the Facility" [3].

In accordance with the definition of a MAE and Section 4.2.2, all hazards ranked with a severity of 'Very High - M' (i.e. multiple fatality events) were identified as contributing to a MAE. Based on a gap assessment, certain MAE related hazards were identified that are outside the scope of the Base Safety Case, hence are subject to assessment in this SCR FSA document. The linkage between the SCR MAE identified and the range of hazards is indicated on the hazard register provided in Appendix E.

The SCR MAEs were also subject to:

- Bowtie analysis, as per Section 4.3.2
- FEA, as per Section 4.4
- NFHA, as per Section 4.5

Table 9: Major Accident Events

Category	MAE ID	MAE Description	Comments
Non-Flammable MAE	MAE-WTW.01	Gangway System Failure	New MAE due to inherent hazard associated with persons being at height on the gangway system.
Fire & Explosion MAE	MAE-WTW.02	Loss of Hydrocarbon Containment from Adjacent Facility During Gangway Operations	Similar to MAE-05 in the Base Safety Case. Some changes due to vessel positioning requirements, and additional causes / consequences.
Non-Flammable MAE	MAE-WTW.03	Vessel Collision During Gangway Operations	Similar to MAE-08 in the Base Safety Case. Some changes due to vessel positioning requirements, and additional causes / consequences.
Non-Flammable MAE	MAE-WTW.04	Dropped Object / Swinging Load (WTW Project)	Additional causes of a dropped object under Base Safety Case MAE-13 (i.e. crane collision with gangway)

4.3.2 Bowtie Analysis

Bowtie analysis is a qualitative process incorporating the qualitative aspects of fault-tree and event-tree analyses and provides a visual representation of the relationships between the causes of incidents, the controls preventing the incident from occurring, the escalation of incidents to a range of outcomes, and the mitigation controls in place to limit the consequences. The bowtie model concept is illustrated in Figure 32. The bowtie diagrams are provided in Appendix F.

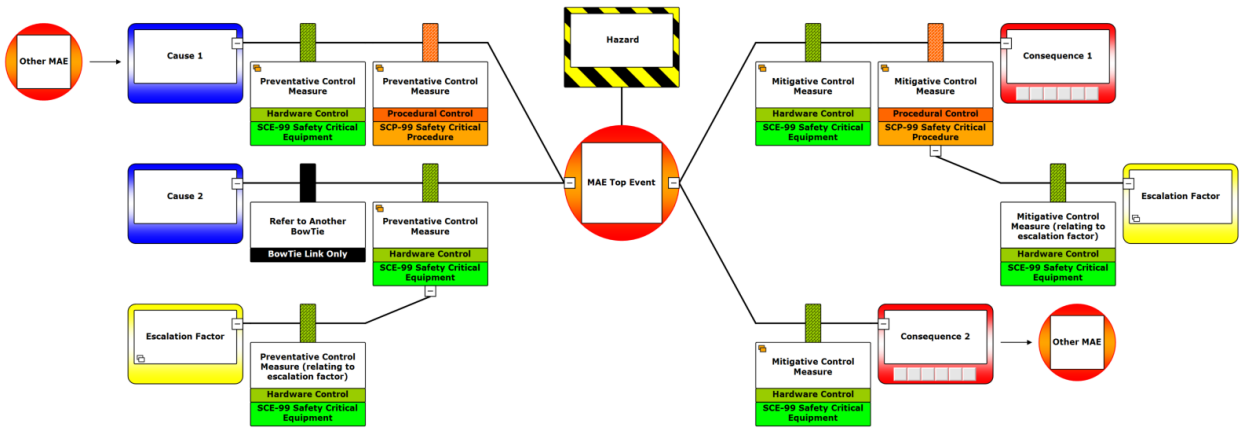


Figure 32: Bowtie Concept

NOTE: Some hardware and procedural controls are depicted by the addition of the term 'RFWI'. These indicate additional controls added to existing MAE as part of the NOPSEMA RFWI process.

4.3.2.1 Methodology (Bowtie)

Information regarding the bowtie methodology is provided in Base Safety Case FSA Section 3.2, including:

- Assigning SCE and SCP to various controls and their significance
- The use of Common Causal Factors (CCF)
- Bowtie linkages to other bowtie diagrams

The complete list of bowtie diagrams, each corresponding to either a MAE or a CCF, is provided in Table 10. The additional project MAE bowties are highlighted grey.

Table 10: Bowtie Diagrams

MAE ID	MAE Description	Type
MAE-01	Engine Room Fire	Base Safety Case MAE
MAE-02	Fire on Back Deck	
MAE-03	Accommodation Fire	
MAE-04	Gas Bottle Explosion / Fire	
MAE-05	Loss of Hydrocarbon Containment (Subsea / Topsides)	
MAE-06	Loss of Stability	
MAE-07	Helicopter Crash	
MAE-08	Vessel Collision	
MAE-09	Uncontrolled Movement of Equipment on Board	
MAE-10	Exposure to Unsafe Atmosphere	
MAE-11	Man Overboard	
MAE-12	Persons Fall from Height	
MAE-13	Dropped Object / Swinging Load	
MAE-WTW.01	Gangway System Failure	WTW Project SCR MAE
MAE-WTW.02	Loss of Hydrocarbon Containment from Adjacent Facility During Gangway Operations	
MAE-WTW.03	Vessel Collision during Gangway Operations	
MAE-WTW.04	Dropped Object / Swinging Load (WTW Project)	
CCF-01	Human Error	Common Causal Factor (CCF)
CCF-02	Adverse Weather	
CCF-03	Loss of Station Keeping	

4.3.2.2 Bowtie / MAE Interrelationship

There is an interrelationship between the SCR MAEs and other MAEs and CCFs in the Base Safety Case. For example, a vessel collision due to losing position is one of the potential causes of a hydrocarbon release on an adjacent platform (MAE-WTW.02), and CCF-03 in the Base Safety Case captures a wide range of controls in relation to prevention of a loss of DP. The SCR MAE bowties therefore reference other bowties in the Base Safety Case, using bowtie links, as per Base Safety Case FSA Section 3.2.2.

Whether a link is to a whole bowtie, or just to a certain cause, consequence or escalation factor is apparent based upon the link text shown in the bowtie diagrams.

4.3.2.3 Bowtie / MAE Workshop

Workshop sessions were undertaken to assess the MAEs in conjunction with workforce and stakeholders, as outlined in Section 4.1.4.

The MAE aspect of the sessions involved the following main steps:

- A systematic review of the applicable MAEs using the bowtie methodology
- Consideration and identification of causes, consequences, escalation factors and control measures
- The identification of additional control measures that could potentially reduce the risk associated with the MAEs to a level that is ALARP
- Risk ranking the safety related consequences in accordance with the Risk Analysis Matrix (refer to Figure 31)

The outcome of the MAE workshop was recorded in the bowtie diagrams which are provided in Appendix F. Any additional risk reduction measures identified for consideration were added to the Recommendations Register (Appendix G), for subsequent close-out as part of the ALARP demonstration process (refer to Section 4.8).

The bowtie diagrams continued to be developed during the FSA process, in particular as a result of any other controls that were identified and accepted for implementation during various safety studies (e.g. FEA, EERA, ESSA).

4.3.3 Safety Critical Equipment / Procedures

The Base Safety Case FSA Section 3.3 defines a range of Safety Critical Equipment (SCE) and Safety Critical Procedures (SCP). During development of the SCR, in particular during bowtie analysis, SCE and SCP were also identified with respect to the new MAEs. After this, a gap assessment was undertaken to identify which SCE and SCP associated within the SCR are outside the scope of the Base Safety Case.

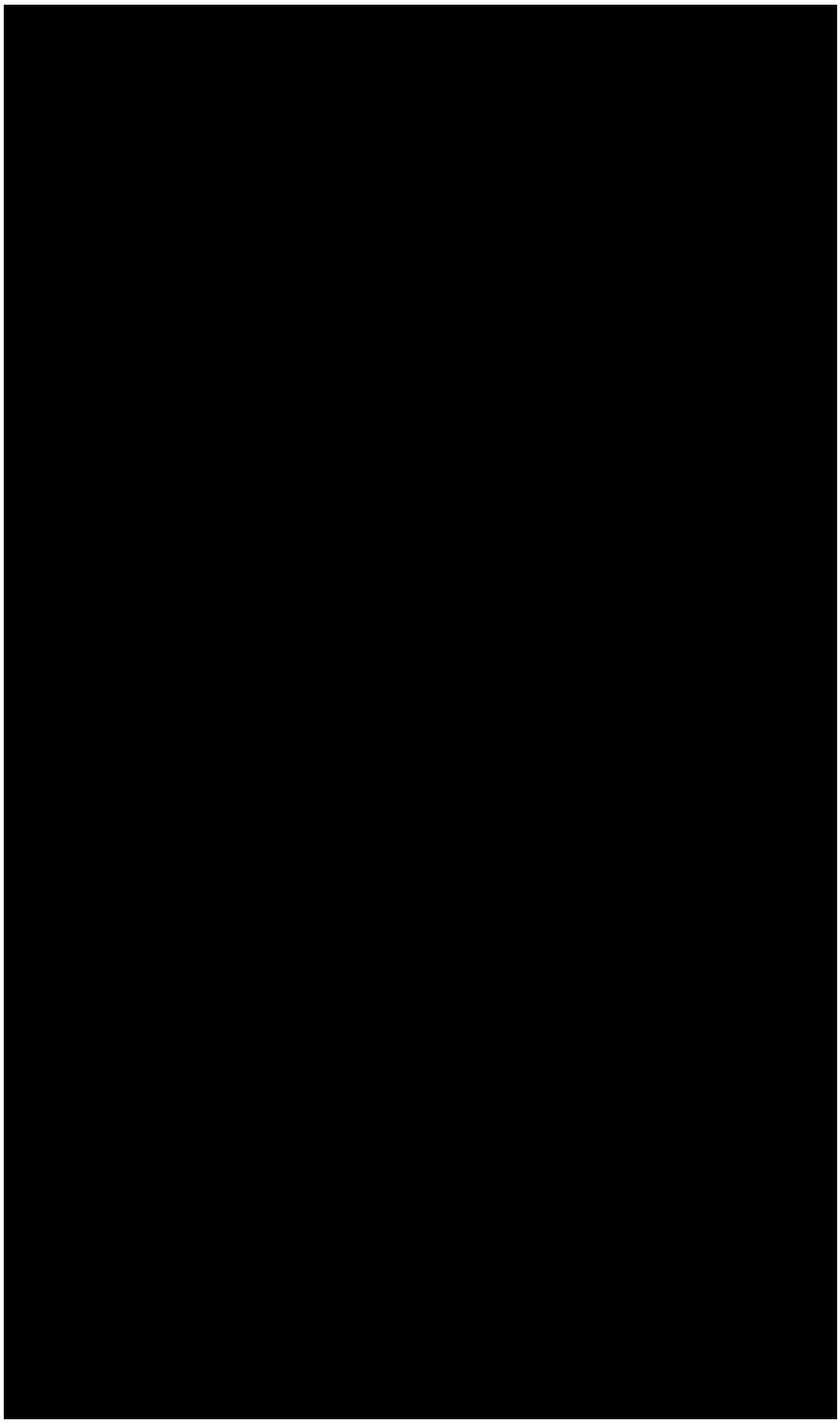
Based on the gap assessment with respect to the Base Safety Case, the additional SCE and SCP are listed in Table 11. The additional SCE and SCP are described within this SCR, as per the references provided in Table 11.

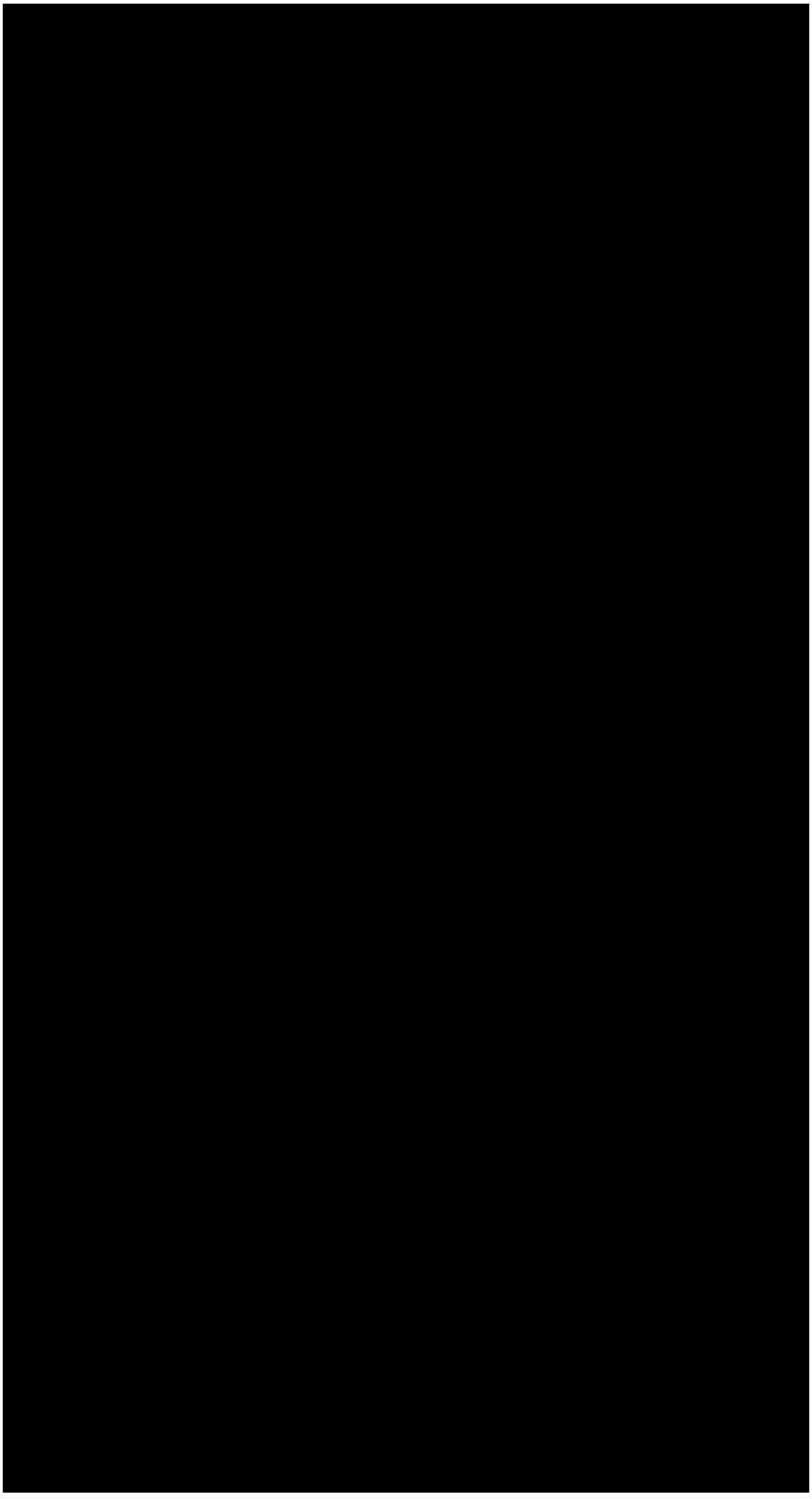
The range of direct SCE and SCP that relate to prevention or mitigation of the new MAEs are indicated on Figure 33 and Figure 34 respectively. Further SCE and SCP also apply based on MAE inter-relationship.

The OPGGS(S) Regulations require validation of SCE, as per Section 1.10.

Table 11: Safety Critical Equipment / Procedures

ID	Name	SCR Section References
Safety Critical Equipment (SCE)		
SCE-WTW.01	Gangway System	Section 2.3
Safety Critical Procedures (SCP)		
SCP-WTW.01	Gangway Procedures	Section 3.3 Section 3.4





4.4 FIRE AND EXPLOSION ANALYSIS (FEA)

This section of the FSA presents a description of the FEA undertaken during SCR development. The FEA considers the effects of hydrocarbons hazards associated with the field and platform in relation to the SCR gangway vessel activities.

The general structure and approach is aligned with that of the Base Safety Case FSA Section 4.

4.4.1 Objectives

The objectives of the FEA are to:

- Assess the potential, likelihood and consequence of the events identified
- Give due consideration to the technical and other control measures
- Identify additional control measures that may reduce risks associated with fires, explosions, and gas releases, and that may be reasonably practicable to implement
- Provide information on which to assess the impact of the respective fire, explosion and gas release events on escape, evacuation and rescue from the vessel, and the vessel's emergency systems, as per the EERA (Section 4.6) and ESSA (Section 4.7) respectively

NOTE: The EERA also provides detailed assessment of the escape, evacuation and rescue systems that apply to mitigating the various MAEs and should be referred to for such information.

Additional risk reduction measures identified during the FEA were added to the Recommendations Register (refer to Appendix G). The decision regarding the implementation of such control measures was made as part of the ALARP demonstration process, as described in Section 4.8.

4.4.2 FEA Events

The scope of the FEA is limited to the assessment of fire and explosion MAEs associated with the SCR scope of activities. General fire and explosion hazards on the vessel are assessed within Base Safety Case FSA Section 4.

On the basis of the HIRA and gap assessment, the SCR FEA is limited to consideration of the event MAE-WTW.02, which relates to a loss of hydrocarbon containment from an adjacent facility during the course of WTW / gangway operations. The MAE identified is closely related to MAE-05 in the Base Safety Case, since it covers a hydrocarbon release from an adjacent facility. However, the principal differences are:

- The SCR MAE is required to identify the controls necessary to reduce the level of risk to ALARP associated with all potential vessel positions at PLA (refer to Section 3.3.5)
- The SCR MAE is required to address the gangway related controls in the context of a hydrocarbon release

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Due to the similarities between MAE-05 and MAE-WTW.02, the focus in the SCR assessment was on:

- Assessing the inventory and consequences of a release, and comparing them to the Base Safety Case, mainly to establish that they are within the limits of the Base Safety Case, but also to appreciate the risk to the gangway
- Re-defining the pertinent preventative and mitigative controls in the context of the WTW Project to account for the above described MAE differences

The fire, explosion and gas release events that have MAE potential on the vessel were identified using the following methods:

- The HIRA study and associated workshop (refer to Section 4.2 and Appendix E – Hazard Register Summary)
- Bowtie analysis and the associated MAE / bowtie workshop (Section 4.3)
- Pluto Safety Case
- This FEA

In addition to assessing MAE related events, an assessment is also provided of a hydraulic oil fire and electrical fire in the context of the gangway.

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4.4.4 Methodology (FEA)

The FEA methodology adopted is as described in Base Safety Case FSA Section 4.3.

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<u>Sea Surface Boil Zone</u>

Although a dropped object on subsea infrastructure was identified as a potential cause of a hydrocarbon release, the potential is largely eliminated due to the robust elimination controls (i.e. no platform or vessel crane lifting during gangway operations), so there is very limited potential for a subsea hydrocarbon release.

Any subsea release associated with a subsea loss of containment during the project activities is anticipated to produce a sea surface boil zone, given the water depth and pressurised gas within the subsea infrastructure. The same principles and effects apply as described in Generic Safety Case FSA Section 4.14. It is therefore concluded that negligible static loss of stability would occur, although dynamic effects are a risk to the vessel.

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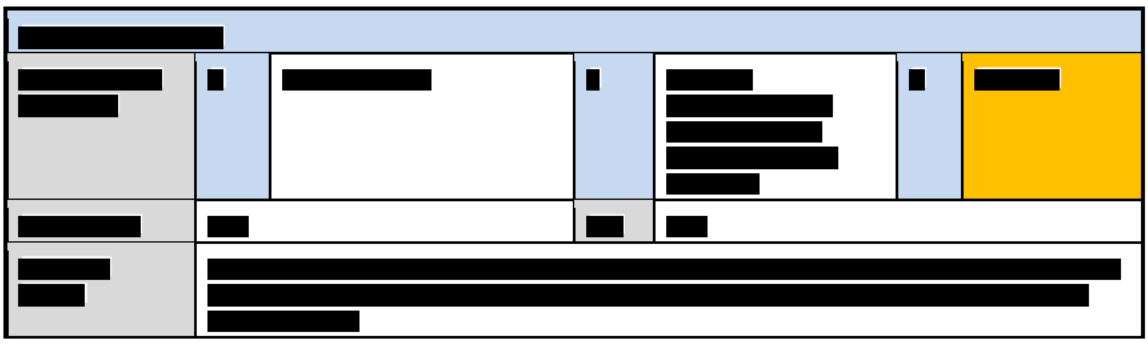

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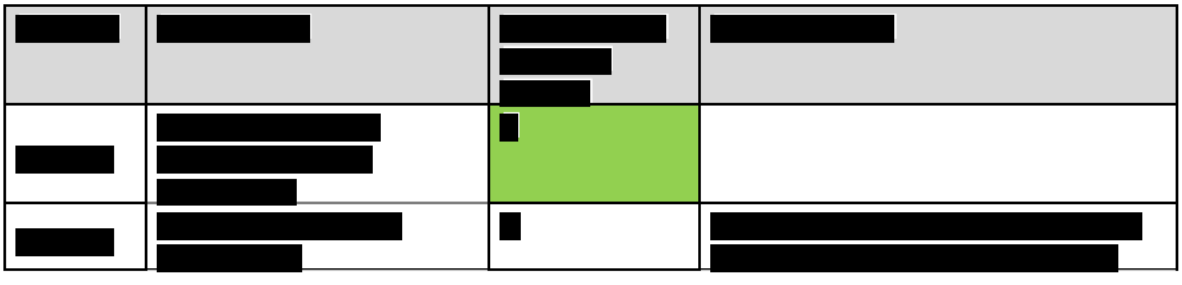

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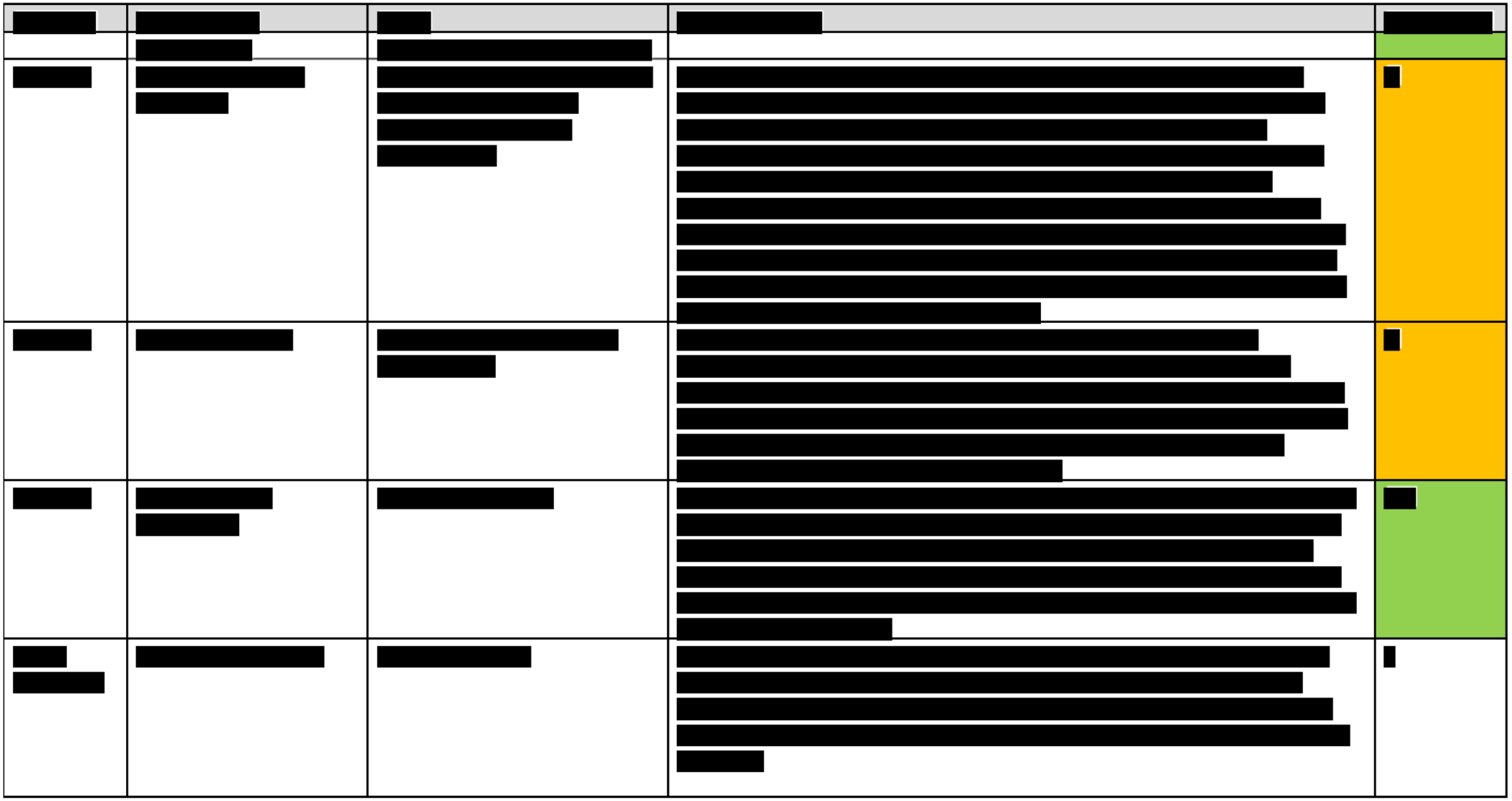

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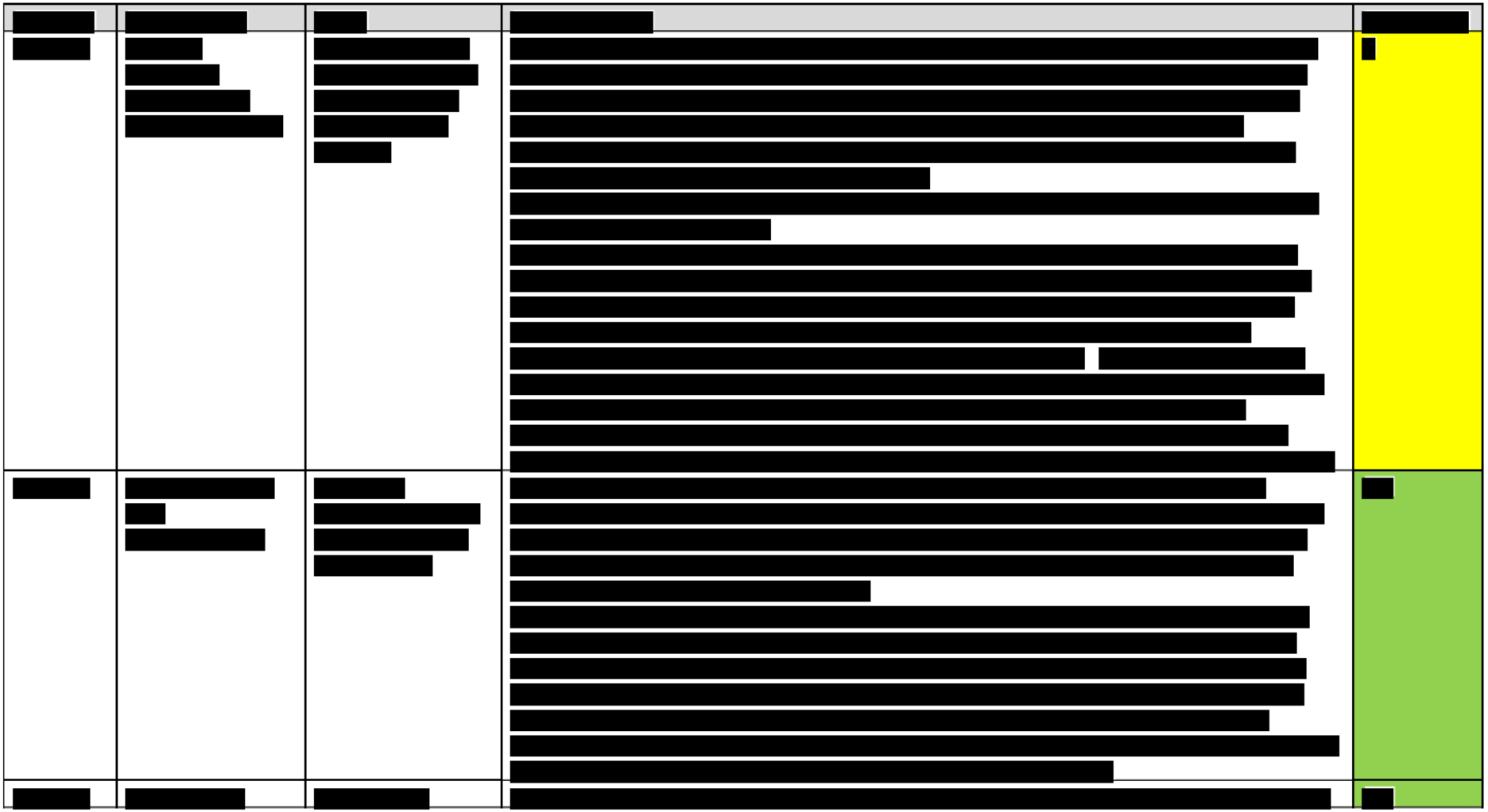

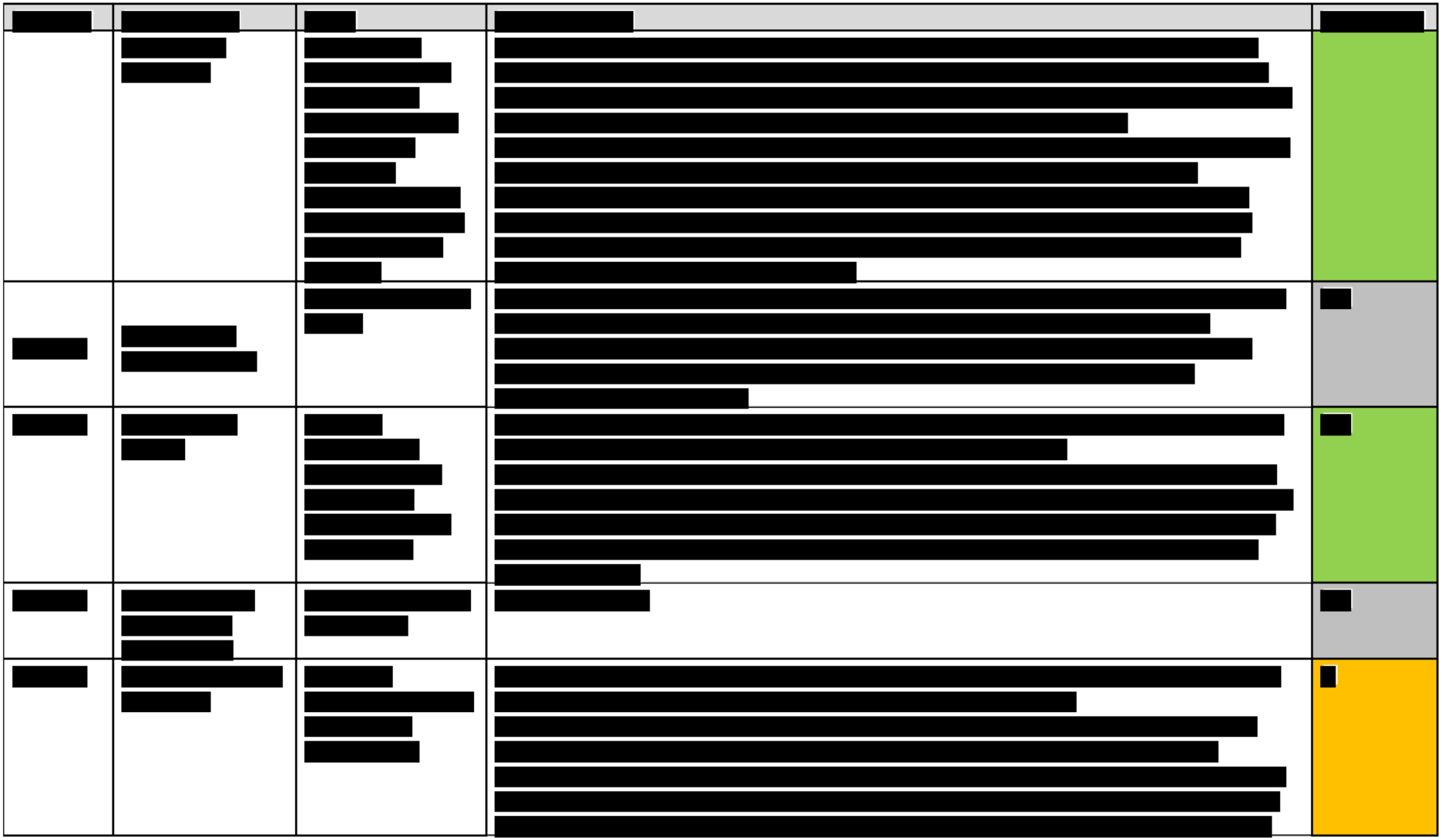

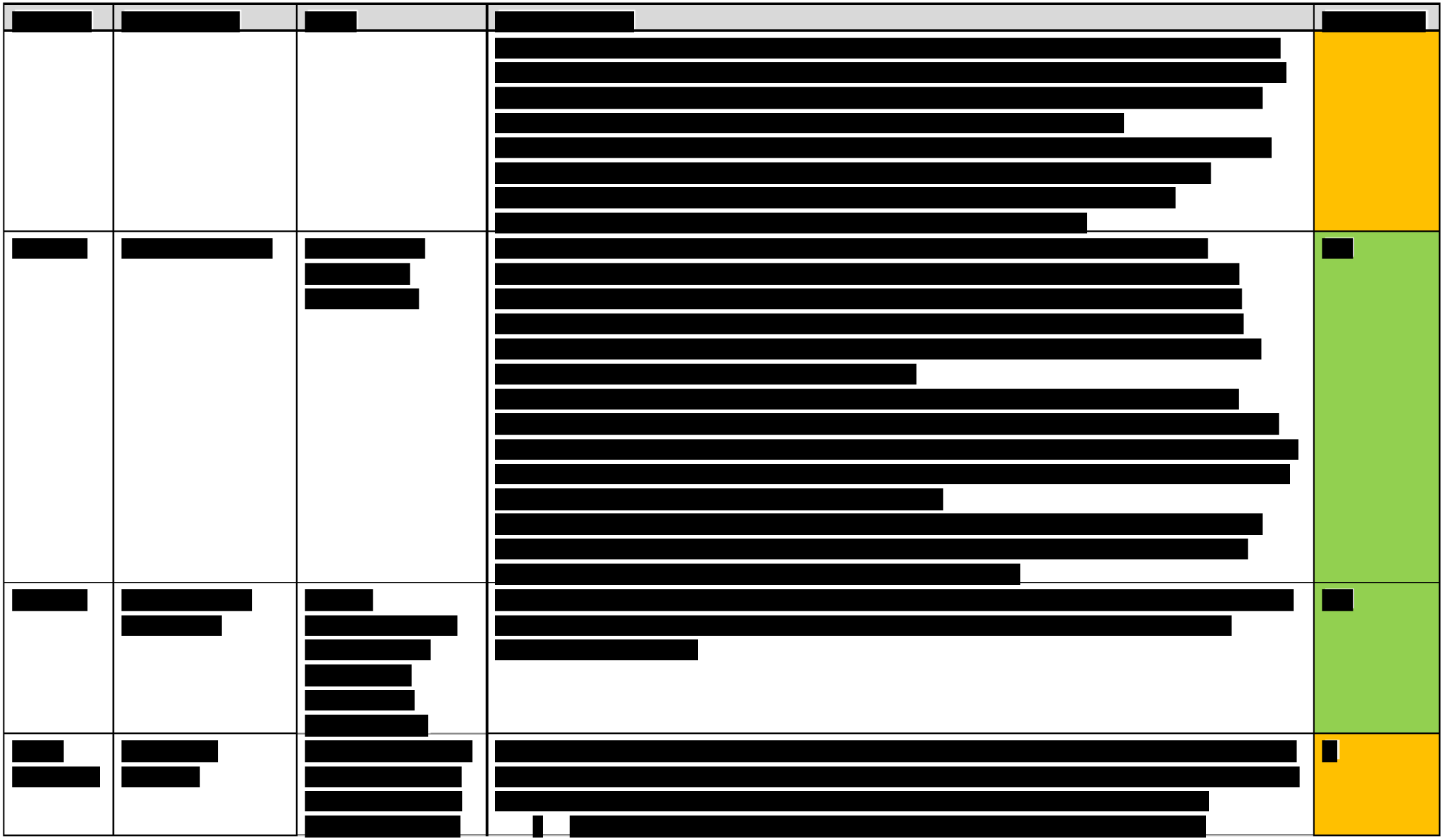

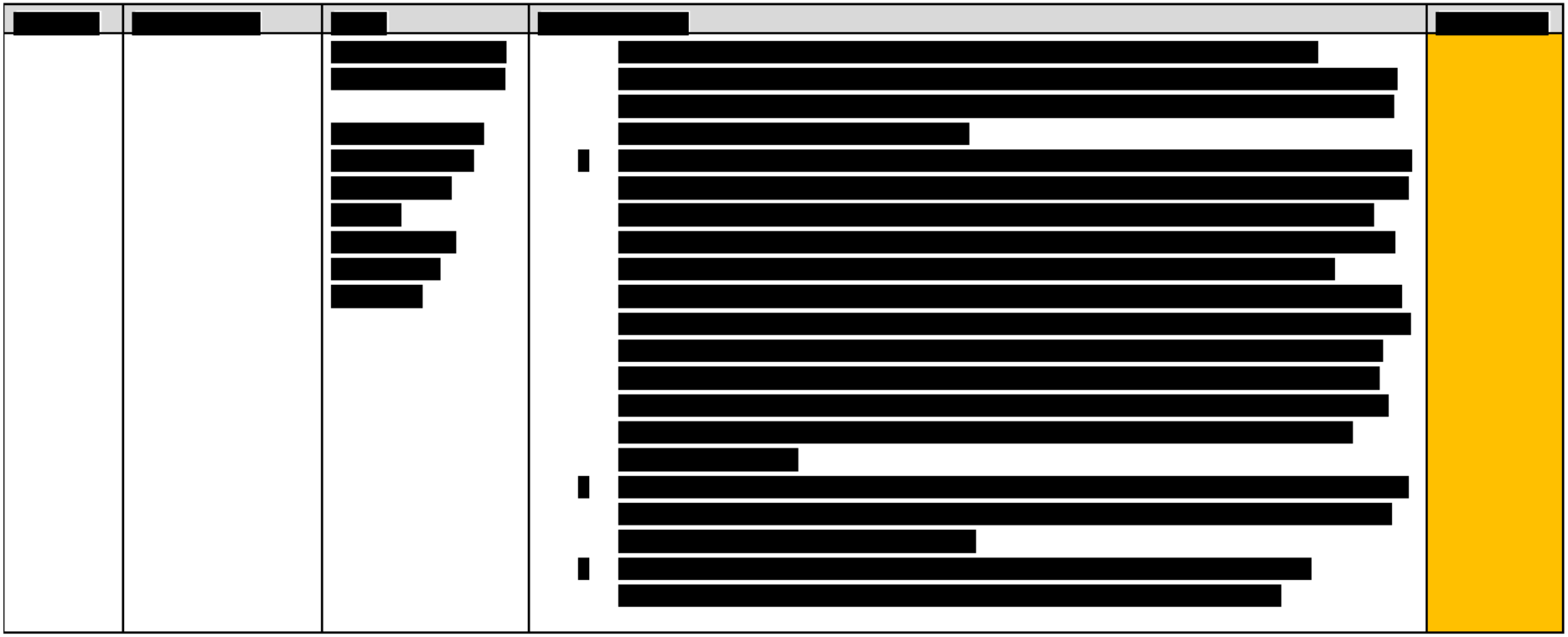

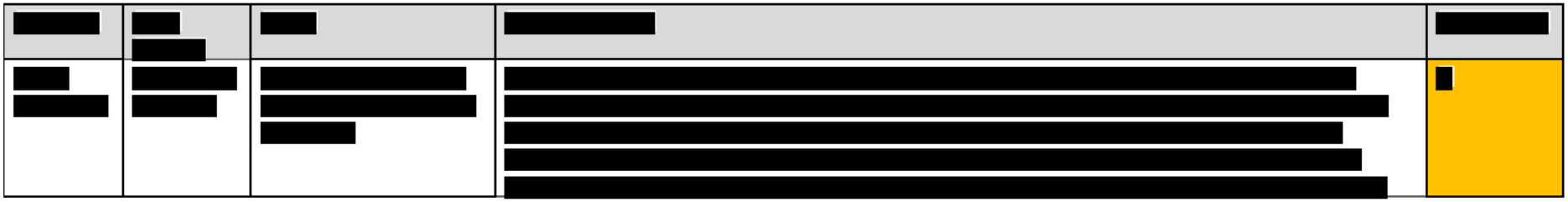

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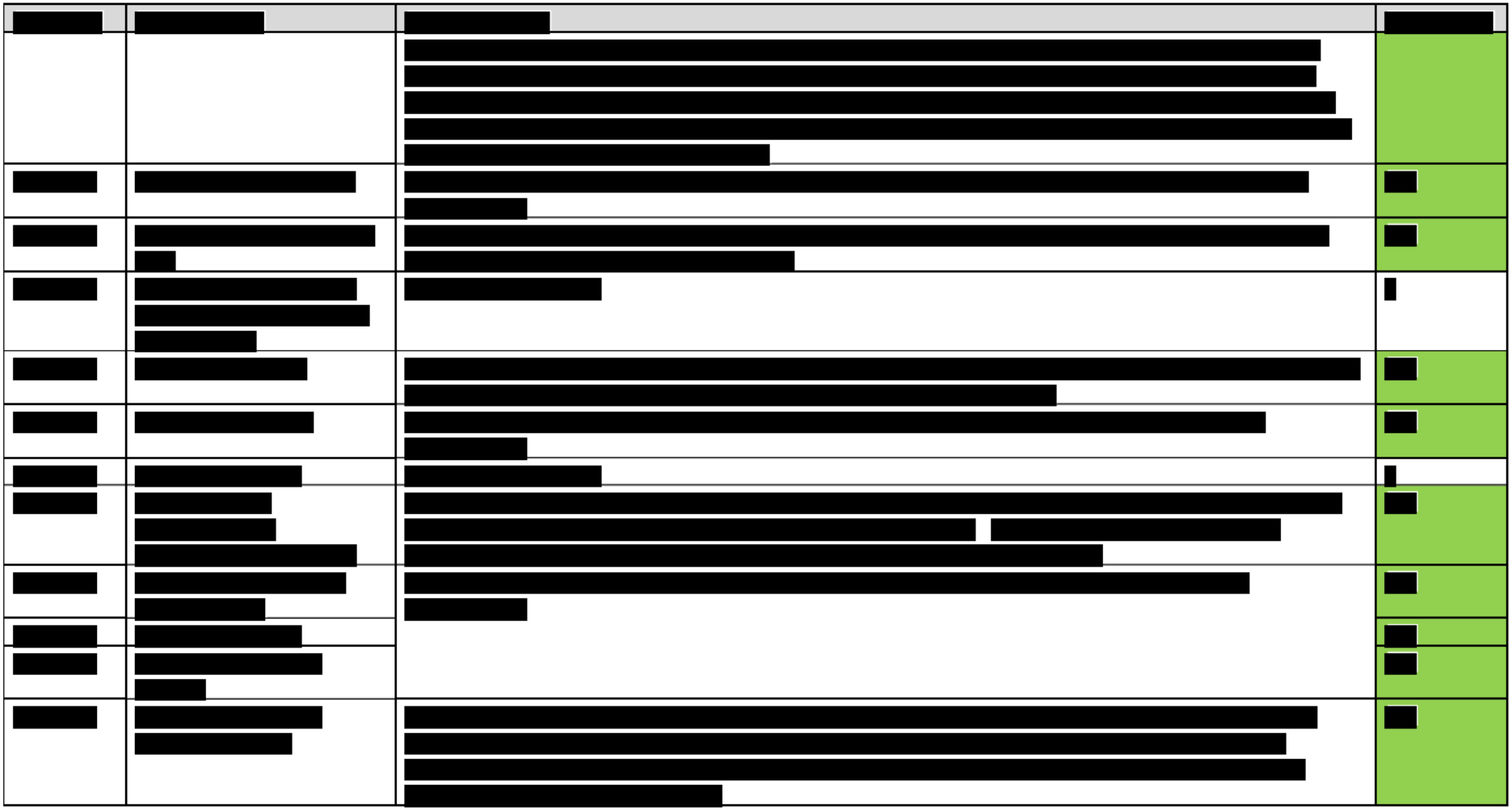

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4.8 ALARP DEMONSTRATION

4.8.1 Overview

A fundamental objective of the FSA process is to demonstrate that the risk associated with MAEs has been reduced to a level that is ALARP. This means that all possible risk measures have been put in place unless it was not reasonably practicable to do so.

The primary mechanism by which this has been achieved is through consideration and implementation of the following:

- Compliance with industry codes and standards
- Compliance with good practice
- Undertaking an FSA to identify further risk reduction measures

Further information on each of the above is provided in Base Safety Case FSA Section 8.1.

In relation to the FSA, a series of recommendations regarding potential additional risk reduction measures were identified (i.e. in addition to those normally in place). Each recommendation was recorded in the Recommendations Register (Appendix G), considered during the ALARP review process (refer to Section 4.8.3), and incorporated back into the FSA. Further information regarding the Recommendations Register framework to support the ALARP demonstration is provided below.

The accepted recommendations are also recorded on the bowties, described in the Section 2 and Section 3, and are closed-out in accordance with the commitment date outlined in the Recommendations Register.

4.8.2 Recommendations Register

The Recommendations Register framework implemented was as described in Base Safety Case FSA Section 8.2. A summary list of the recommendations identified is provided in Table 26, later in this section of the SCR.

4.8.3 ALARP Evaluation Process

Recommendations identified during safety case development were initially screened and evaluated with respect to the following:

- Decision context
- ALARP basis
- Introduced risks
- Alternatives

Further information on each of the above points is provided in Base Safety Case FSA Section 8.3. Where relevant to the decision made, discussion regarding such matters is provided in the Recommendations Register.

4.8.4 ALARP Workshops

ALARP reviews were undertaken at various phases of SCR development, comprising:

- During the FSA workshop sessions
- During subsequent meetings / teleconferences and correspondence

The objective of the ALARP review was to evaluate the recommendations identified during SCR development in accordance with the safety case ALARP demonstration framework.

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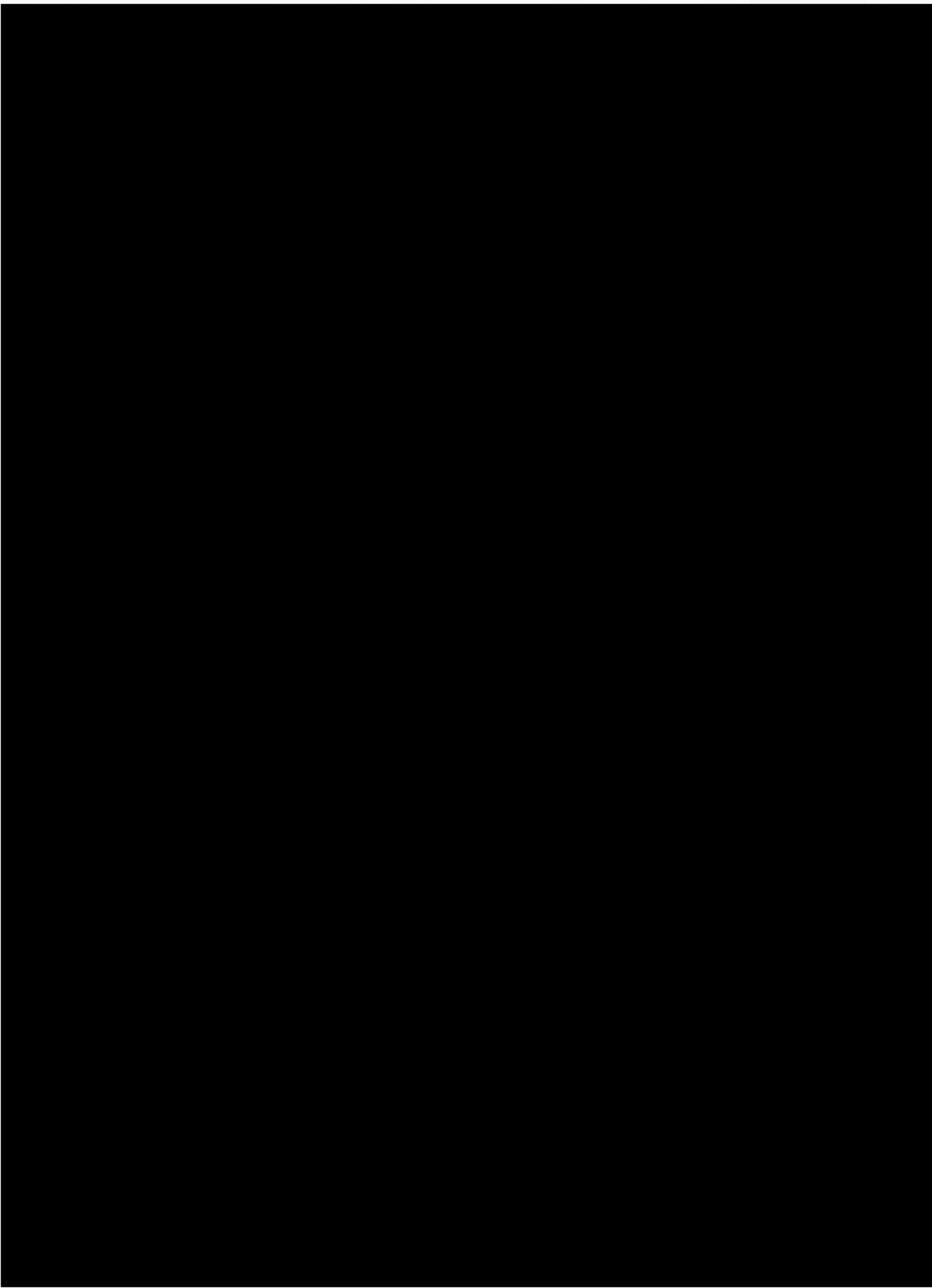
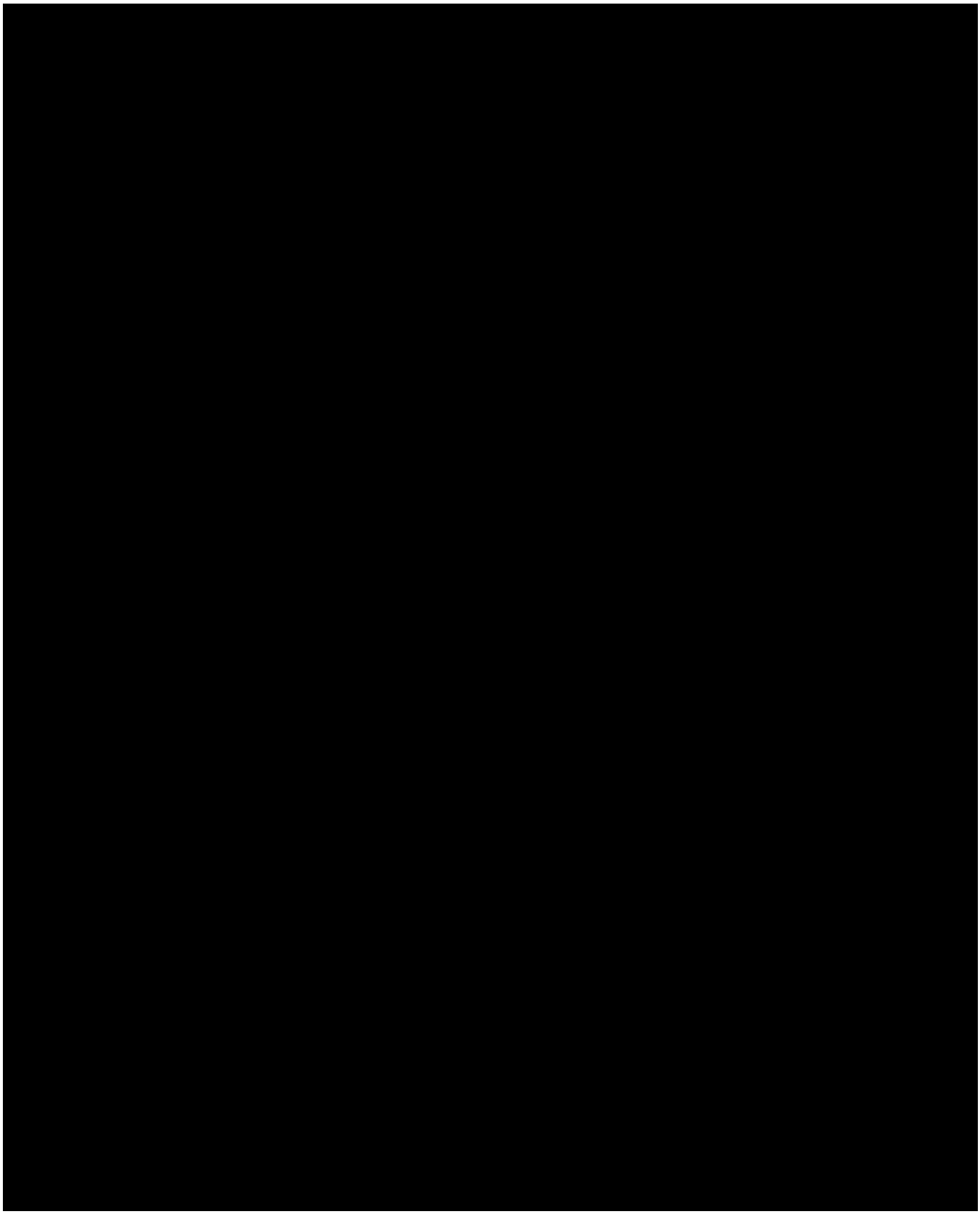
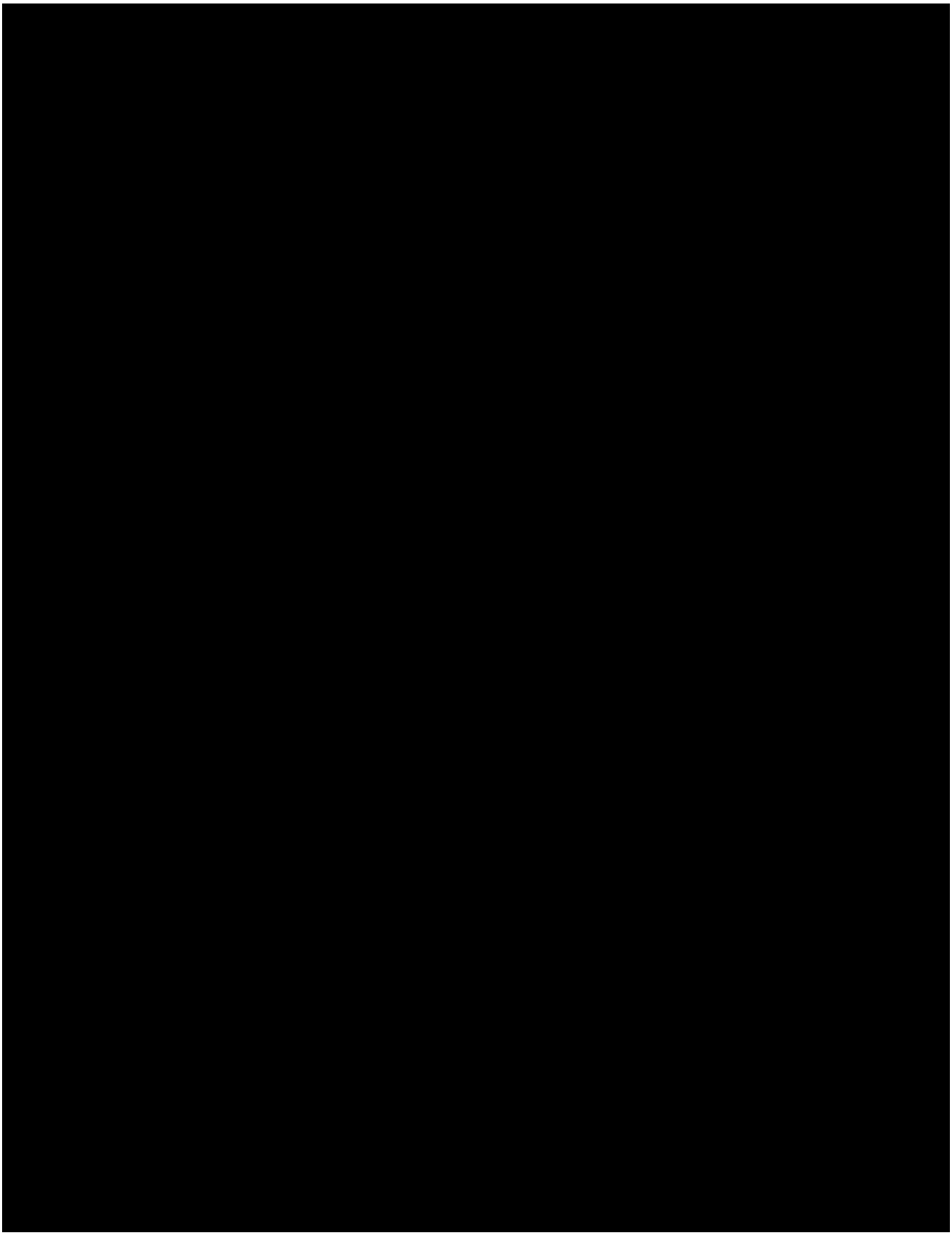
APPENDIX A GANGWAY BROCHURE

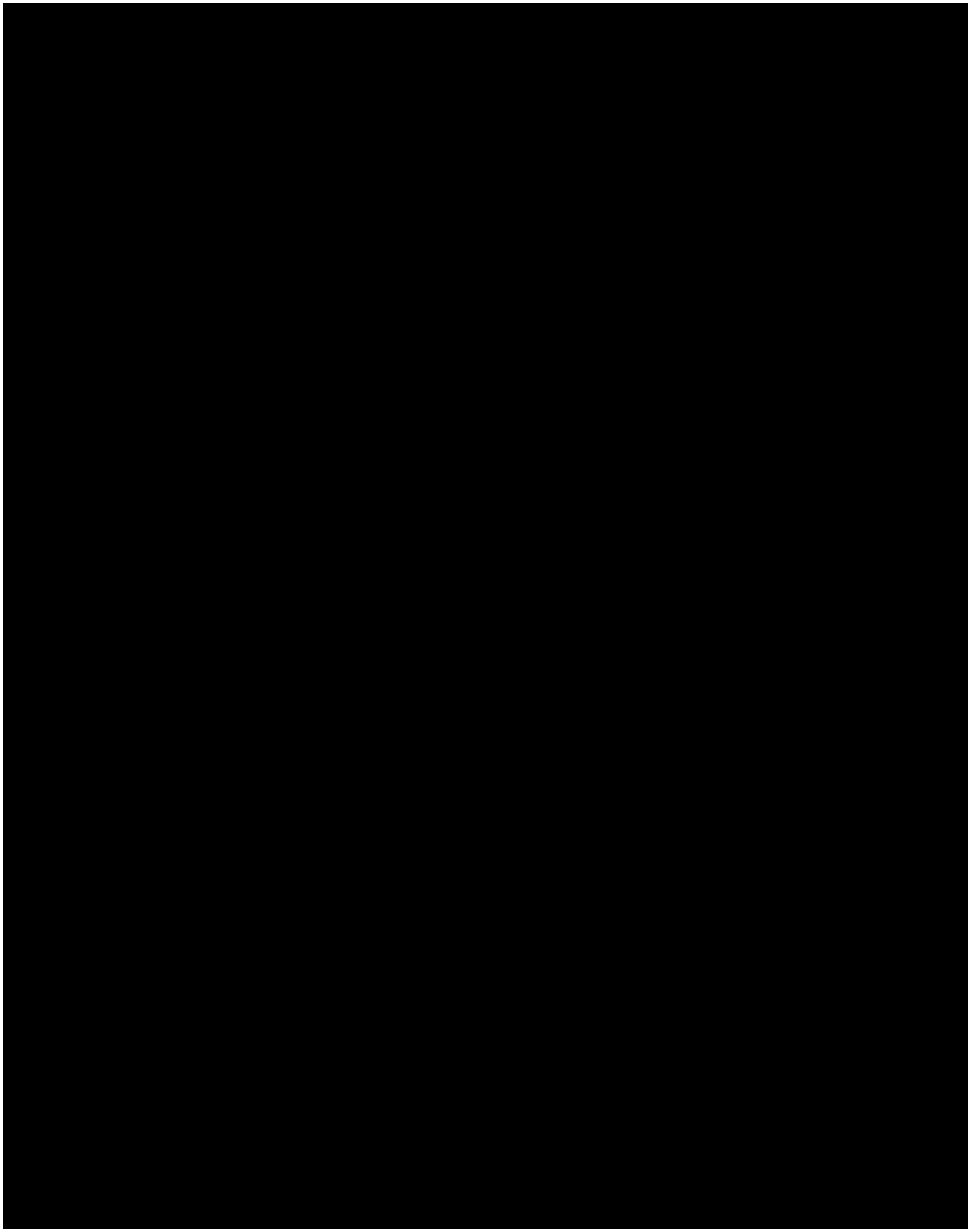


APPENDIX B DRAWINGS

APPENDIX C HYDROCARBON RESPONSE PLAN





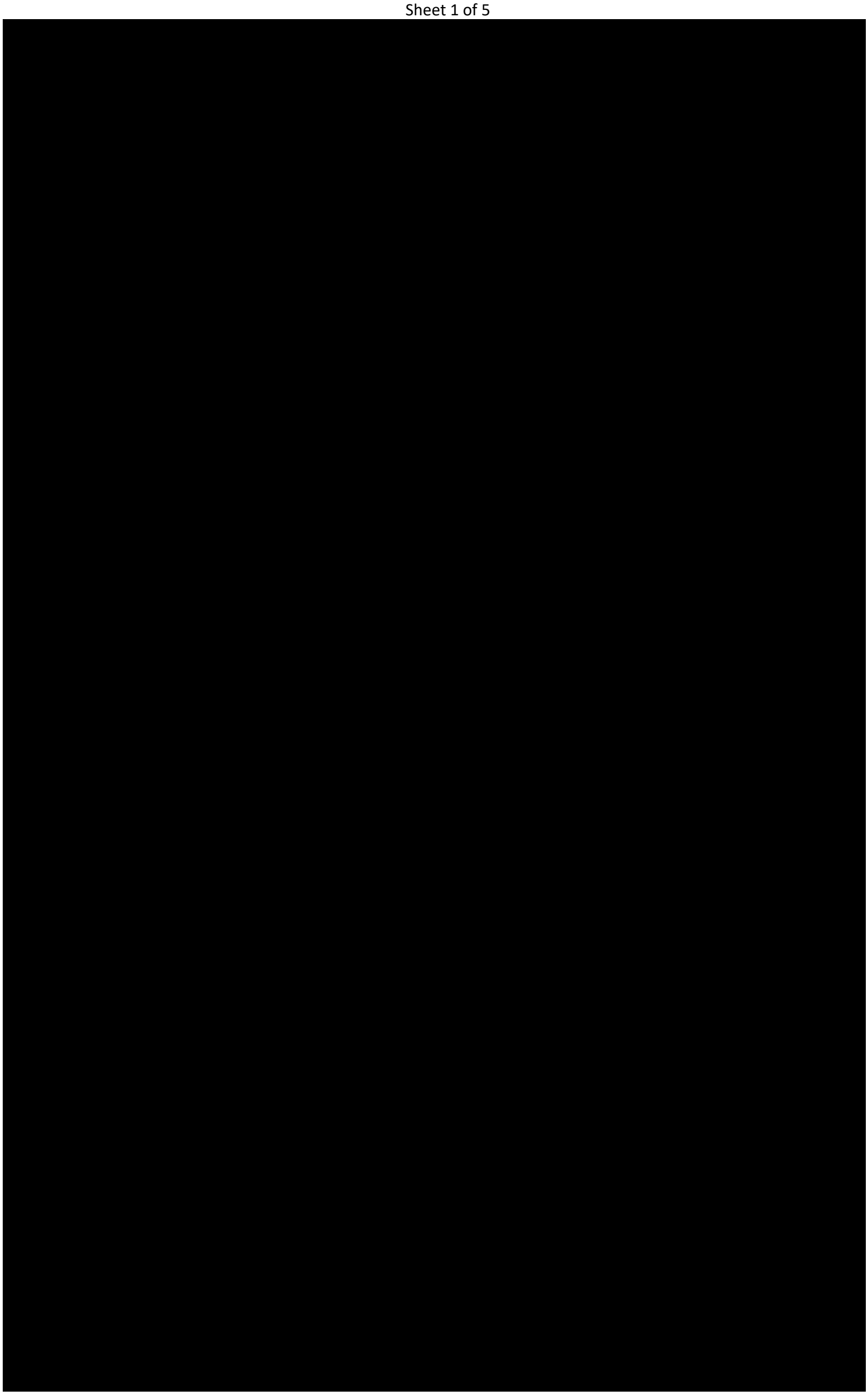


APPENDIX D ATTENDANCE REGISTERS

APPENDIX E HAZARD REGISTER SUMMARY

APPENDIX F BOWTIE DIAGRAMS

MAE-WTW.01 Gangway System Failure



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APPENDIX G RECOMMENDATIONS REGISTER