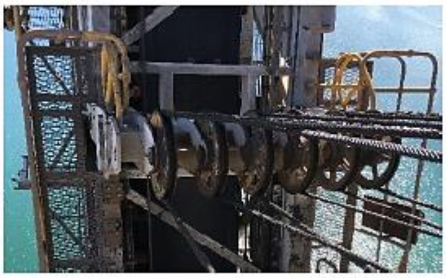
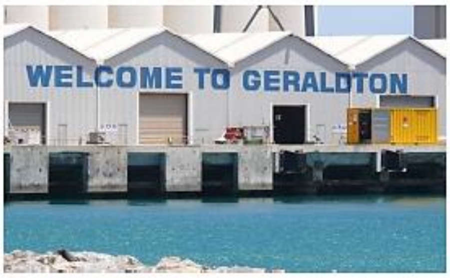
MID WEST PORTS

TECHNICAL GUIDELINE

MWPA301 – BULK HANDLING FACILITY GUIDELINES – GENERAL



Version	Revision Date	Details	Prepared By	Authorised By
Rev 0	04/05/2018	ISSUED FOR USE	GHD	TF
Rev 1	8/01/2020	OPERATING DATA ADDED	SC	CS

1. CONTENTS

1. PREFACE

The purpose of this guideline is to provide relevant technical information to assist in the planning and execution of engineering projects and maintenance activities at Mid West Ports Authority's Geraldton Port Bulk Handling Facility (BHF).

These guidelines are intended to be used to provide a high level technical basis for:

- Brownfields upgrade and replacement projects that are likely to be undertaken from time to time by Mid West Ports Authority (MWPA)
- Planning and executing non-routine maintenance activities
- The design of generic equipment and structures associated with the Bulk Handling Facility (conveyors, transfer chutes, shiploader components, towers, feeders, dust extractions systems and unloaders)
- Condition assessment and risk management activities required for Shiploaders

This guideline has been created to provide guidance on technical issues and for use in development of technical specifications for specific projects.

In conjunction with the existing MWPA100 General Technical Guidelines, these guidelines also provide a framework for packaging and managing projects as envisaged above.

2. APPLICABLE DOCUMENTS

2.1. DOCUMENT PRECEDENCE

As a general guide, where particular aspects are not covered in the MWPA Technical Guidelines or where conflict between documents exists, the following precedence for standards applies:

1. Statutory Regulations
2. Design Codes and Standards
3. Project Specifications
4. MWPA Technical Guidelines
5. Other References (e.g. recognised industry practice, novel technology)

Notwithstanding the general order of precedence, if there is a conflict between documents the clause presenting the more conservative and pragmatic guidance shall govern. If in doubt, or in cases where non-compliance is anticipated, clarification shall be sought from MWPA.

2.2. GOVERNMENT ACTS AND REGULATIONS

All work shall be carried out to comply with the requirements of the Statutory Authorities having jurisdiction over the site. These requirements shall include, but not be limited to, the following, as applicable:

- Western Australian Occupational Safety and Health Act (1984) and Regulations (1996)
- Safe Work Australia Act (2008)
- Western Australia Health Act (1911)
- Western Australian Mines Safety and Inspection Act (1994) and Regulations (1995)
- Radiation Protection and Control Act (1982)
- Electricity Act (1945)
- Electricity Regulations (1947)
- Environmental Protection Act (1986) and Regulations (1987)
- Poisons Act (1964)
- Clean Air Act (1964)
- Pollution of Waters by Oil and Noxious Substances Act (1987)
- WA Mining Act and Regulations (1995) - Amended 2009
- Dangerous Goods Safety Act (2004) and Regulations (2007)
- Site specific Statutory Requirements and Environmental Guidelines
- All associated standards referenced within the above

In each case, the latest edition or issue and amendments thereto of the relevant Standard, Act, Regulation, Code or Guideline at the start of the project shall apply.

2.3. MWPA STANDARD SPECIFICATIONS AND GUIDELINES

This guideline should be read in conjunction with all other parts of the MWPA Technical Guideline series, where relevant, as listed below:

- MWPA 000 Series – Port Development Guidelines
- MWPA 100 Series – General Guidelines
- MWPA 200 Series – Drafting and Surveying Guidelines
- MWPA 300 Series – Mechanical Engineering Guidelines
- MWPA 400 Series – Guidelines for Maritime Structures
- MWPA 500 Series – Civil Engineering Guidelines
- MWPA 600 Series – Buildings and Structures Guidelines
- MWPA 700 Series – Electrical and Instrumentation Guidelines
- MWPA 800 Series – Guidelines for Rail
- MWPA 900 Series – Additional Guidelines

Where the referenced MWPA guidelines do not yet exist, the relevant Australian Standards and industry best practice shall apply.

2.4. AUSTRALIAN STANDARDS

Table 2-1: Applicable Australian Standards

No.	Title
AS/ISO 1000	The international system of units (SI) and its application
AS 1065	Non-Destructive Testing – Ultrasonic Testing of Carbon and Low Alloy Steel Forgings
AS 1100	Technical Drawing
AS 1101.3	Graphical symbols for general engineering – Welding and non-destructive examination
AS 1110	ISO metric hexagon bolts and screws – Product grades A and B
AS 1111	ISO metric hexagon bolts and screws – Product grade C
AS 1112	ISO metric hexagon nuts
AS 1138	Thimbles for wire rope
AS 1163	Cold-formed structural steel hollow sections
AS 1170.0	Structural design actions – General principles
AS 1170.1	Structural design actions - Permanent, imposed and other actions
AS 1170.2	Structural design actions - Wind actions
AS 1170.4	Structural design actions - Earthquake actions in Australia

No.	Title
AS 1171	Non-destructive testing – Magnetic particle testing of ferromagnetic products, components and structures
AS 1210	Pressure vessels
AS 1214	Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)
AS 1237	Plain washers for metric bolts, screws and nuts for general purposes
AS/NZS 1252	High strength steel bolts with associated nuts and washers for structural engineering
AS/NZS 1269	Occupational noise management
AS 1275	Metric screw threads for fasteners
AS 1318	Use of colour for the marking of physical hazards and the identification of certain equipment in industry (known as the SAA Industrial Safety Colour Code)
AS 1319	Safety signs for the occupational environment
AS 1332	Conveyor belting with textile reinforcement
AS 1333	Conveyor belting of elastometric and steel cord construction
AS 1403	Design of rotating steel shafts
AS 1418	Cranes, hoists and winches
AS 1428	Design for access and mobility
AS 1442	Carbon steels and carbon-manganese steels – Hot rolled bars and semi-finished products
AS 1443	Carbon and carbon-manganese steel – Cold finished bars
AS 1444	Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties
AS/NZS 1554	Structural steel welding set
AS 1627	Metal finishing – Preparation and pre-treatment of surfaces
AS 1653	Methods of test for rubber
AS 1654.1	ISO system of limits and fits – Bases of tolerances, deviations and fits
AS 1654.2	ISO system of limits and fits – Tables of standard tolerances grades and limit deviations for holes and shafts
AS 1657	Fixed platforms, walkways, stairways and ladders - Design, construction and installation
AS/NZS 1664.1	Aluminium Structures – Limit state design
AS/NZS 1664.2	Aluminium Structures – Allowable stress design
AS/NZS 1665	Welding of aluminium structures
AS 1666.1	Wire-rope slings - Product specification
AS 1666.2	Wire-rope slings – Care and use
AS 1683	Methods of test for elastomer
AS/NZS 4024	Safety of machinery - Conveyors

No.	Title
AS 1710	Non-destructive testing – Ultrasonic testing of carbon and low alloy steel plate and universal sections – Test methods and quality classification
AS 1796	Certification of welders and welding supervisors
AS 1831	Ductile cast iron
AS 1866	Aluminium and aluminium alloys – Extruded rod, bar, solid and hollow shapes
AS 2074	Cast Steel
AS 2177	Non-destructive testing – Radiography of welded butt joints in metal
AS 2207	Non-destructive testing – Ultrasonic testing of fusion welded joints in carbon and low alloy steel
AS 2317	Collared eyebolts
AS 2321	Short-link chain for lifting purposes
AS 2382	Surface roughness comparison specimens
AS 2625.1	Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts - General guidelines
AS 2671	Hydraulic fluid power - General requirements for systems (ISO 4413:1998, MOD)
AS 2700	Colour standards for general purposes
AS 2729	Rolling bearings - Dynamic load ratings and rating life
AS 2740	Wedge-type sockets
AS 2741	Shackles
AS 2759	Steel wire rope – Use, operation and maintenance
AS 2784	Endless wedge belt and V-belt drives
AS 2788	Pneumatic fluid power – General requirements for systems
AS 3552	Conveyor belting – Guide to splicing steel cord belt
AS 3569	Steel wire ropes - Product specification
AS/NZS 3678	Structural steel – Hot rolled plates, floor plates and slabs
AS/NZS 3679	Structural steel – Hot rolled bars and sections
AS 3709	Vibration and shock – Balance quality of rotating rigid bodies
AS 3782.1	Acoustics – Statistical methods for determining and verifying stated noise emission values of machinery and equipment
AS 3844	Site testing of protective coatings
AS/NZS 3931	Risk Analysis of Technological Systems – Application Guide
AS 3990	Mechanical equipment - Steelwork
AS 4002.1	Hydraulic fluid power - Particulate contamination of systems - Method of coding the level of contamination
AS 4024.1	Safety of machinery

No.	Title
AS 4024-3610	Safety of machinery – General Requirements
AS 4024-3611	Safety of machinery – Belt conveyors for bulk materials handling
AS 4024-3614	Safety of machinery – Conveyors – Mobile and transportable conveyors
AS 4037	Pressure equipment - Examination and testing
AS 4100	Steel structure
AS 4324.1	Machines for continuous handling of bulk materials
AS 4343	Pressure equipment – Hazard levels
AS 4458	Pressure equipment - Manufacture
AS 4497.1	Roundslings -Synthetic fibre - Product specification
AS 4497.2	Roundslings -Synthetic fibre - Care and use
AS 4738.1	Metal castings - Ferrous sand moulded
AS 4775	Emergency eyewash and shower equipment
AS 4991	Lifting devices

2.5. INTERNATIONAL STANDARDS

Table 2-2: Applicable International Standards

International Standard	Standard Title
ISO 113	Rolling bearings – Plummer block housings – Boundary dimensions
ISO 281	Rolling bearings - Dynamic load ratings and rating life
ISO 1999	Acoustics – Determination of occupational noise exposure and estimation of noise-induced hearing impairment
ISO 5048	Continuous mechanical equipment for belt conveyors
ISO 5801	Fans - Performance testing using standardized airways
ISO 9001	Quality Management Systems – Requirements
ISO 10823	Guidelines for the selection of roller chain drives
ISO 12759	Fans - Efficiency classification for fans
ISO 14694	Industrial fans - Specifications for balance quality and vibration levels
ISO 19499	Mechanical vibration - Balancing - Guidance on the use and application of balancing standards
BS 4235	Specification for Metric Keys and Keyways
CEMA 7	Belt conveyor for bulk materials (7th Edition)

3. BULK HANDLING FACILITY OPERATING INFORMATION

3.1. SITE DATA

Refer to MWPA300 – Mechanical Engineering Guidelines for relevant site data.

3.2. GENERAL INFORMATION

General information related to the Geraldton Port facility may be found on the MWPA website, general technical information regarding Geraldton Port may be found in the MWPA100 – General Guidelines document.

3.3. MATERIAL CHARACTERISTICS

3.3.1. BERTH 4 (MULTI-PRODUCT)

The characteristics of materials to be exported over Berth 4 are shown in Table 3-1 below.

Table 3-1: Non-iron ore material to be exported over Berth 4

Non-Iron Ore Products	Characteristics						
	Bulk Density (T/m^3)	Stowage Factor (m^3/T)	Repose Angle (°)	Size (mm)	Flow Rate (tph)	TML [3]	Moisture Content
Zircon [[1]]	2.8 – 3.2	0.33	35 - 37	<0.45	1200 / 1600	No Requirement	-0.10%
Rutile [1]	2.6 – 2.8	0.37	35 - 37	<0.45	1200 / 1500	No Requirement	-0.10%
Ilmenite [1]	2.3 – 2.6	0.41	35 - 37	<0.45	1000 / 1500	No Requirement	-0.10%
Synthetic Rutile [1]	1.6 – 1.8	0.58	26 - 28	<0.45	600 / 800	No Requirement	-0.10%
SREP [1]	1.6 – 1.8	0.58	26 - 28	<0.45	500 / 740	No Requirement	-0.10%
Garnet [1]	2.38	0.44	28	0.2 – 0.6	1100 / 1300	No Requirement	-0.10%
Copper Concentrates [1]	2.10	0.47	39 +	0.037 – 0.15	800 / 1000	11.40%	9% - 10%
Zinc Concentrate [1]	2.10	0.47	39 +	0.053 – 0.15	1000 / 1250	11.40%	9% - 10%

Lead Concentrate [1]	2.10	0.47	38 +	0.037 – 0.15	1000 / 1250	12% - 15 %	6% - 10%
Talc [1]	1.6 - 1.7	0.6	28 - 35	25 – 150	1000 / 1350	No Requirement	0.1%- 1%

3.3.2. BERTH 5 (IRON ORE)

The material characteristics used in the design criteria for the Berth 5 BHF circuit (including the shiploader) are shown in Table 3-2 below; A surcharge angle of 20° is applicable for all material.

The circuit is currently configured for Mount Gibson hematite only. Actual throughputs for the circuit are up to 3500tph maximum depending on bulk density of the product, with the bottleneck being conveyor belt capacity.

Table 3-2: Iron Ore Material - Berth 5

Iron Ore Products		Characteristics						
		Bulk Density (T/m3)	Stowage Factor (m3/T)	Repose Angle (°)	Size (mm)	Flow Rate (tph)	TML	Moisture Content
Mount Gibson	Magnetite	2.2	N/A	38	97% < 0.045	5000	N/A	9% - 10%
	Fines	2.5	0.4	36	-6	5000	N/A	1% - 4%
	Lump	2.42	0.42	38	-32 + 6	5000	N/A	1% - 3%
	Pellet	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Midwest (Sinosteel)	Fines	1.6 / 2.1	0.45	37	98% < 8	5000	N/A	3.50%
	Lump	1.3 / 1.5	0.65	37	95% < 32	5000	N/A	2%
	Pellet	2.2	0.45	35	8 < 99% < 16	5000	N/A	1% - 3%
Gindalbie	Fines	2.72	N/A	35	< 6.3	5000	N/A	2 - 6%
	Lump	2.35	N/A	35	95% < 32	5000	N/A	2 - 4%

Notes:

1. Data sourced from GPA document "CHARACTERISTICS OF PRODUCTS SHIPPED THROUGH THE BULK HANDLING FACILITY" updated 22 October 2002.

2. Nugget handling deleted from consideration at GPA Board Meeting 18th May 06.

3. Magnetite handling deleted from consideration at GPA Board Meeting 18th May 06.

4. Data sourced from Midwest Corp. Ltd document "GPA Material Data for Iron Ore Products 3 Nov 2005".

3.4. SITE MAPS AND SITE PLANS

See the following drawings (shown in Appendix A) for the Geraldton Port site map:

- **010-G-0202** – BHF PLANT EQUIPMENT & FACILITIES (MAP 1 OF 2)
- **010-G-0203** – BHF PLANT EQUIPMENT & FACILITIES (MAP 2 OF 2)

3.5. FEEDER & CONVEYOR SCHEDULE

The parameters of the feeders and conveyors installed at MWPA Geraldton Port are provided in the Tables below. Note that certain conveyors and feeders are owned and operated by customers and information below may be incorrect or superceded. Site verification is required to confirm the information.

Table 3-3: Truck Unloader Circuit (Berth 4)

Conveyor No.	Description	Drawing No.	Belt Width (mm)	Belt Speed (m/s) @50Hz	Tape Length (m)	Installed Power (kW)
FD03	Truck Unloading Feeder	G3-1010	1800	0.26	35	37
CV08	Truck Unloading Outload Conveyor 1	G3-1017	1000	3.03	76	90
CV09	Rotating Conveyor (CV400 Feed)	G3-1023	1000	3.26	14	5.5
CV400	Truck Unloading Outload Conveyor 2	75309405-4310	900	3.62	25.3	37
CV401	Mineral Sands and Talc Storage Outload Conveyor 1	75309405-4320	900	4.53	247.3	132
CV04	Berth 4 Load-out Conveyor	22279-110, 75309405-4400	900	3.52	600	110, 75
CV05	SL04 Feed Conveyor 1 (Mineral Sands)	420-301	1200	2.23	13.4	22
CV06	SL04 Discharge Conveyor	44915-GHD-DPE-335	1200	3.4	81.82	110

Table 3-4: Lease 21 Circuit (EMR – Berth 4)

Conveyor No.	Description	Drawing No.	Belt Width (mm)	Belt Speed (m/s) @50Hz	Tape Length (m)	Installed Power (kW)
PCV1	MMG Storage Outload Conveyor 1	710-M-1002	1000	1.5	125	37
PCV2	MMG Storage Outload Conveyor 2	710-M-1003	1000	1.5	125	37
CV02	MMG Outload Conveyor 3	75309405-4200	900	3.17	250	110

Conveyor No.	Description	Drawing No.	Belt Width (mm)	Belt Speed (m/s) @50Hz	Tape Length (m)	Installed Power (kW)
CV03	Metal Concentrates Storage Facilities Outload Conveyor	N/A	1000	3.06	225.75	132
CV04	SL04 Feed Conveyor 2 (Metal Concentrate)	Refer Table 3-3				

Table 3-5: Lease 27 Circuit (IGO – Berth 4)

Conveyor No.	Description	Drawing No.	Belt Width (mm)	Belt Speed (m/s) @50Hz	Tape Length (m)	Installed Power (kW)
CV27	IGO Storage Outload Conveyor	260721-612	900	2.167	85	90
CV03	Metal Concentrates Storage Facilities Outload Conveyor	Refer Table 3-4				
CV04	SL04 Feed Conveyor 2 (Metal Concentrate)	Refer Table 3-3				

Table 3-6: MGI Circuit (Berth 5)

Conveyor No.	Description	Drawing No.	Belt Width (mm)	Belt Speed (m/s) @50Hz	Tape Length (m)	Installed Power (kW)
FD01	Train Unloader Feeder	4191-MAN-01 (Rev 0), 46931-SH1-4	1800	0.33	20.183	220kW
CV01B	Train Unloading Facility Unload Conveyor 1	300-ME-010	1350	2.4	118.3	185
CV02B	Train Unloading Facility Unload Conveyor 2 (TT02B)	300-ME-030	1200	2.8	123.7	185
CV03B	Train Unloading Facility Unload Conveyor 2 (TT102)	300-ME-050	1200	2.8	71.7	75
CV103	TT103 Feed Conveyor	023540DM-033	900	3.1	183.9	185
MGM INLOAD CV	Lease 17 Storage Shed Stacker	TBA	TBA	TBA	TBA	TBA
OCV01	MGM Storage Outload Conveyor 1 (Feed to CV500)	TBA	TBA	TBA	TBA	TBA
OCV02	MGM Storage Outload Conveyor 2 (Feed to CV500)	TBA	TBA	TBA	TBA	TBA

Conveyor No.	Description	Drawing No.	Belt Width (mm)	Belt Speed (m/s) @50Hz	Tape Length (m)	Installed Power (kW)
CV500	Iron Ore Storage Area Outload Conveyor 1	75309405-4210	1350	3.4	466	185
CV501	Iron Ore Storage Area Outload Conveyor 2	75309405-4330	1350	3.4	241	280
CV502	CV 501 to CV 503 Conveyor	75309405-4510	1350	3.4	95.5	185
CV503	SL05 Feed Conveyor	75309405-4520	1350	3.4	704	250
CV504	SL05 Discharge Conveyor	Z130900	1400	3.5	133	250
CV602	Alternate Outload to Lease 26 Storage	811-ME-010	1200	2.8	185	185
CV603	Lease 26 Storage Shed Stacker	801-ME-060	1200	2.8	450	132
FD606	Berth 5 Storage Facility Belt Feeder	801-ME-060	2000	0.5	22	185
FD607	Berth 5 Storage Facility Belt Feeder	801-ME-060	2000	0.5	22	185
FD608	Berth 5 Storage Facility Belt Feeder	801-ME-060	2000	0.5	22	185
CV610	Berth 5 Storage Facility	821-ME-030	1350	3.74	330	185
CV611	Feed to CV503	821-ME-050	1350	3.6	250	355

Table 3-7: Lease 88 Circuit (Top Iron - Berth 5)

Conveyor No.	Description	Drawing No.	Belt Width (mm)	Belt Speed (m/s) @50Hz	Tape Length (m)	Installed Power (kW)
CV300	Top Iron Truck Unloading Conveyor 1	2319-M-007	900	3.05	144	90
CV301	Top Iron Truck Unloading Conveyor 2 (to CV 302)	2319-M-011	900	3.15	238	55
CV302	Top Iron Storage Inload Conveyor	2319-M-015	900	3.15	277	75
CV303	Top Iron Ore Storage Outload Conveyor 1	3129-M-022	1200	0.9	26.8	90
CV304	CV500 Feed Conveyor 1 (Top Iron Ore)	2139-M-023	1200	1.06	10.2	18.5

Conveyor No.	Description	Drawing No.	Belt Width (mm)	Belt Speed (m/s) @50Hz	Tape Length (m)	Installed Power (kW)
CV305	Top Iron Ore Storage Outload Conveyor 2	3129-M-022	1200	0.9	26.8	90
CV306	CV500 Feed Conveyor 2 (Top Iron Ore)	2139-M-023	1200	1.06	10.2	18.5
CV500	Refer Table 3-6					

Table 3-8: Lease 13 Circuit (Sinosteel - Berth 5)

Conveyor No.	Description	Drawing No.	Belt Width (mm)	Belt Speed (m/s) @50Hz	Tape Length (m)	Installed Power (kW)
CV109	Sinosteel Truck Unloading Conveyor	761010-4320	600	3	TBA	75
CV110	Sinosteel Truck Unloading Conveyor	761010-4320	600	3	TBA	45
CV104	CV105 Feed Conveyor	761010-4401	900	1.4	TBA	TBA
CV105	Sinosteel Storage Inload Conveyor	761010-4501	900	1.4	TBA	TBA
CV106	Sinosteel Storage Outload Conveyor 1	761010-4620	1600	0.5	12	55
CV107	Sinosteel Storage Outload Conveyor 2	461010-4620	1600	0.5	12	55
CV500	Refer Table 3-6					

Table 3-9: Karara Circuit (Berth7)

Conveyor No.	Description	Drawing No.	Belt Width (mm)	Belt Speed (m/s) @50Hz	Tape Length (m)	Installed Power (kW)
TBC						

3.6. DUST COLLECTORS

The parameters of the dust collection systems installed at MWPA Geraldton Port are provided in Table 3-3.

Table 3-3: Berth 4 and 5 Dust Collectors

Dust Collector No.	Location	Drawing No.	Servicing	Specification	Installed Power (kW)
DC01	Train Unloader	N/A	Train Unloader, CV01B, CV02B, CV03B, CV401/501 tail	No visible nameplate	TBA
DC02	TT103	N/A	TT103 conveyor transfer points	TBA	TBA
DC03	CV03	2016 11 09 DC03 general arrangement	CV03 Feed & Discharge points	No visible nameplate	TBA
DC04	Truck Unloader	001-M-0013	Truck unloader, FD01, CV08, CV09, CV400 transfer points	No visible nameplate	90
DC05	SL04	4215-GS12GA-001, 23266-001	SL04, CV05, CV06 transfer points	Dust Collector Make/Model; Camfill Farr GS12L	18.5
DC06	TT501	75309405-8009	CV501, CV502 Transfer points	Luhr DFV 2.2/1.5/80/18	22
DC07	TT502	TBA	CV503	TBA	TBA
DC08	TT501	3450-SK1-A, 56089-001	CV401 head end, CV04 feed points	Mideco ECP32	11
DC08A	TT501	3450-SK1-A	CV401 head end, CV04 feed points	Luhr DFV 1.9/1.0/2.0	TBA
DC09	SL05	Z132000	SL05 Transfer Points	ZPMC	18.5

4. GENERAL REQUIREMENTS

4.1. CONTRACT DOCUMENTS

Unless otherwise specified, all mechanical work shall be in accordance with the General Conditions of Contract, the Contract Specifications, Contract Drawings, this Guideline and the documents listed in Section 2 above.

This document is not intended to replace bespoke project basis of design, design criteria or specifications but is intended to provide developers, designers and contractors with a benchmark for which their equipment and designs must meet on a technical basis.

4.2. PREFERRED EQUIPMENT

The MWPA places very high importance on equipment selection and commonality. Judicious selection of equipment can result in reducing the stock of emergency spares carried on site and assists in efficiency of maintenance due to a good understanding by the maintenance staff of the installed equipment.

When selecting mechanical equipment for new projects, preference shall be given to items that are interchangeable or common with equipment currently in use at MWPA and performing satisfactorily.

Refer to Section 5.2 for rationalization principals of BHF equipment and parts.

Table 4-1: MWPA Preferred Equipment

Equipment	Preferred Manufacturer
Gearboxes	Rossi Bevel Helical
Brake Motors	SEW
Electric Motors	Toshiba High Efficiency Motors
Steel wire ropes	CASAR
Winches and sheaves	Nobles
Bearings and Housings	NSK, FAG
Locking elements	Ringfeder
Hydraulic motors	Rexroth/Hagglunds
Gearbox Oil	Synthetic unless specifically noted
Lifting Eyes & Lashing	RUD

4.3. HEALTH, SAFETY AND ENVIRONMENTAL REQUIREMENTS

For general HSEQ requirements refer to **MWPA100 – General Guidelines, MWPA300 – Mechanical Engineering Guidelines**, the MWPA Contractor Handbook and service drawings, as well as the documents available on the Mid West Port's website.

4.4. PROTECTIVE COATINGS

The protective coatings that shall be used are referred to in the **MWPA401 – Guidelines for Protective Coatings.**

4.5. ACCESS CLEARANCES FOR OPERATION, INSPECTION AND MAINTENANCE

The following clearances should be maintained as a minimum:

Vertical Clearance:

Over pumps and drives	300 mm
Over walkways, passageways and platforms	2100 mm
“Bobcat” or equivalent clearance	2500 mm

Horizontal:

At drive end of equipment	1200 mm
At non drive end of equipment	1000 mm
Passages and elevated walkways	750 mm
Where occasional access is required	600 mm
“Bobcat” or equivalent clean up access	2000 mm

4.6. NOISE / VIBRATION

Mechanical equipment noise levels shall comply with the requirements of section 4.2 of **MWPA300 Mechanical Engineering Guidelines**.

4.7. GUARDING

All plant and equipment shall be guarded in accordance with statutory requirements. Conveyor guarding criteria are specified in **Section 5.8.7**.

4.8. SAFETY IN DESIGN

Safety in Design is based on the understanding that the most significant opportunity to deliver a safe working environment exists during the design phase of a project. At this point designers and engineers have the greatest chance to make changes to a proposed design to arrive at a safe solution.

Safe design is a process defined as:

> *“The integration of hazard identification and risk assessment methods early in the design process to eliminate or minimise the risks of injury throughout the life of the product being designed. It encompasses all design including facilities, hardware, systems, equipment, products, tooling, materials, energy controls, layout, and configuration”.*

Reference: *Australian Safety and Compensation Council Guidance of the principles of safe design for work, 2006.*

Any new or modified bulk handling equipment to be installed at the bulk handling facility shall include a formalised and documented SiD process. Generally, this shall take the form of formalised and documented design reviews at project specific milestones as well as the generation and updating of a live risk register document.

To obtain maximum benefit from the SiD process it is important that the full spectrum of stakeholders is represented at these design reviews, including Port Engineers, Designers, Operators, Maintenance personnel and any other parties who may have valuable experience to contribute. The process should consider all possible phases of the new equipment delivery, including:

- Construction
- Normal operations
- Emergencies
- Maintenance
- Future works on or around the asset
- Decommissioning

5. CONVEYORS

Effective conveyor design is essential to any bulk handling facility, and as such, the design or modification of conveyor systems shall be in conjunction with these guidelines, and Australian Standards. Recommended design limits and equipment selection is presented in this section to assist in conveyor design and equipment selection.

In addition, the 'CEMA Belt Conveyor for Bulk Materials' handbook (7th edition) is recommended to further assist in design parameters.

5.1. DESIGN PARAMETERS

5.1.1. VOLUMETRIC CAPACITY AND EDGE DISTANCE

The design shall ensure minimum spillage by considering a combination of belt edge distance, material surcharge angle as well as maximum rock size and frequency. Where conveyors are to have their throughput increased, consideration shall be given to increasing the speed when the volumetric loading as a percentage of the maximum recommended by CEMA exceeds the values in Table 5.1.

Table 5-1: Maximum recommended loading for various belt types

% of CEMA Loading	Type of belt
85%	General plant conveyors with maximum lump size is less than 50 mm
80%	General plant conveyors with maximum lump size is between 50 mm and 200 mm
75%	Conveyors with travelling trippers

5.1.2. CONVEYOR RESISTANCE AND DRIVE POWER

The calculation of operating power and tensile forces for conveyors shall be in accordance with ISO 5048.

The drive power shall be calculated for the following conditions where appropriate:

- The empty conveyor
- The loaded conveyor at design capacity and maximum bulk density. In confined areas such as tunnels, conveyors shall be designed for flooded belts at maximum bulk density
- Any partially loaded situation which gives a higher maximum power or a negative power
- Power required to clear a blocked chute
- Any "crash" stop scenario which could result in a combination of the above loads

A design margin between installed and consumed power shall be taken to cater for:

- Losses due to voltage drop
- Losses due to the starting mechanism employed

5.1.3. DRIVE TRACTION

All conveyors shall be designed so that slip will not occur at the driving pulley when accelerating or braking under any design load condition based on the stated friction coefficients.

Information on pulley lagging is shown in Section 5.8.1.

Motors shall be capable of starting the fully loaded equipment 6 times in an hour with the last three starts in quick succession. The motors shall be a minimum of Class F, B temperature rise insulation.

For dual pulley drives, the secondary drive shall start before the primary drive. An adjustable timer shall be provided to allow the delay period to be adjusted

5.1.4. CONVEYOR MOTORS AND STARTING TORQUE LIMITS

Conveyor drive units shall be selected so as to provide appropriate control of the starting torque.

- Drives over 15 kW will be started by means of VVVF drive.
- VVVF drives may be considered for smaller drives where control of start tension is critical due to vertical curves, or to reduce the required take-up tensions.

5.1.5. BELT SPEED

Belt speed shall be selected as appropriate to the application and shall be selected to minimize maintenance and avoid the possibility of spillage and excessive power consumption. Belts operating as feeders shall normally be selected from the range 0.25 to 1 m/s. Carrying belts shall be selected from the range 1.0 to approximately 4.0 m/s.

In determining belt speed, + 10% shall be applied to the required process mass flow rate.

5.1.6. BELT SAG

The maximum allowable belt sag based on design capacity loading shall be as per Table 5-2.

Table 5-2: Maximum allowable sag

Condition	Max allowable sag (%)
Steady state	
For any conveyor handling large lumps	1%
For other general application	1.5%
For conveyors with trippers or concave curves	2%
Momentary conditions	4%

5.1.7. INCLINATION AND VERTICAL CURVES

All new conveyors shall have a maximum inclination of 15^{o}. Horizontal loading points are preferred but inclination up to 11.5^{o} at loading points will be accepted subject to approval by MWPA. Loading points shall not be in concave curves.

Where new loading points are to be installed on existing conveyors, if there is no practical alternative, loading points may be installed in a concave curve subject to MWPA approval, as long as:

- No belt lift-off occurs under any loading conditions (in practice and based on calculations using worn belt mass)
- There are no sharp edges on skirts and discharge chute that could damage the belt (the use of round bar welded to the bottom of the skirt plates is suggested)

CONCAVE CURVES

The minimum radius for concave curves shall be determined using a worn belt mass and the maximum starting tension at the upstream curve tangent point. This tension shall be calculated with the belt loaded at the design capacity, from the tail-end loading point to the tangent point.

Where modifications are to be made to existing conveyors, and achieving a sufficient radius to prevent lift off is not practical, consideration may be given to a radius, in which case the following must be addressed:

- The potential for spillage due to belt lift-off
- Possible damage to the belt during lift-off

5.2. RATIONALIZATION

Where practicable the conveyor design shall incorporate equipment and components that are compatible with those used in the existing port operation in order to rationalise spare parts holding. The following rationalization principals should be adopted unless otherwise approved by MWPA:

- New conveyors shall be designed such that new belt widths are not introduced to the BHF.
- Conveyor belting already in use shall be specified (deviations to be approved by the MWPA).
- Idler rollers shall be interchangeable with rollers already installed at the BHF.
- Where possible pulleys shall be interchangeable with existing pulleys. Where this is not possible, bearing centres and plummer blocks will be standardised with existing equipment.
- No conveyor shall have more than three different types of pulleys, unless approved by MWPA.
- Where practical drives will be interchangeable with existing drive units.
- Belt cleaners and ploughs will be as per the current BHF supplier / procedure, unless otherwise specified by MWPA.

5.3. DUST CONTROL, SPILLAGE, AND BELT WASHDOWN

Belt cleaning and washdown shall comply with the relevant MWPA washdown standards.

Washdown procedures at Berth 4 are reflected in the document 'F4.4a Geraldton Port Berth 4 Washdown Matrix', where washdown procedures are dependent on materials being handled. All works related to bulk handling must consider this matrix and the washdown procedures involved when designing or modifying new or existing plant.

Control of dust emissions and eliminating spillage is of high importance to the port. All chutes shall be designed to be integrated into an existing dust collector; or to be fitted with a modular insertable dust collector) where the existing system has insufficient capacity (see **Section 11**). Conveyor and transfer chutes shall generally be designed to minimize dust generation and eliminate spillage.

5.4. STRUCTURAL DESIGN

All conveyor loads shall be obtained from the Mechanical Engineer responsible for the design. The loads provided shall include belt operating, belt starting, aborted start and emergency stopping tensions.

New conveyors should be designed to allow for a future 15% increase in take-up tension. Where existing conveyors are being modified or updated the mechanical engineer shall assess whether allowing for this increase is appropriate and practical.

The aborted start condition can occur when a conveyor is completely "bogged", or the belt is "snagged" and the belt is unable to pull away. In this case a motor can develop a torque well in excess of its design starting torque. The maximum motor torque used for the aborted case shall be determined by the Mechanical Engineer based on the nature of the start control, and an assessment of the risk that the control systems will fail.

A lateral load of 5% of the operating belt tension shall be applied at all pulley mounting locations to ensure stability of the structure.

Operating material load and flooded belt load on a conveyor belt shall be based on the maximum useable cross sectional area, calculated in accordance with Conveyor Equipment Manufacturers' Association (CEMA) recommendations.

5.5. INSTRUMENTATION AND CONTROL

The minimum requirements for Instrumentation and Control are contained in the relevant MWPA Guideline. As a minimum all conveyors shall include the following instruments:

- Pull switches
- Belt alignment switches shall be located in the following locations:
  - 20 m after the loading point
  - 10 m prior to any discharge pulley
  - On return belt prior to a take up bend pulley
  - On return belt prior to tail pulley
- Fluid coupling to be fitted with over temperature switch. In addition, fluid couplings are to be fitted with a high temperature thermal plug

- An under speed detector at the tail pulley to detect belt slip
- Blocked chute switches at transfer chutes
- Belt rip detectors
- Conveyor brakes are to be fitted with switches to detect engaged brake condition, brake open condition and wear detection on the brake pads
- Take up pulley counterweight limits

5.6. MAINTAINABILITY

Maintenance of all components shall be considered in the design of new plant and the design of modification to existing plant. Specifically, the design should aim to:

- Minimize the frequency of required maintenance activities
- Make provision for all maintenance activities to be completed quickly and safely by providing adequate maintenance access and lifting facilities for mechanical equipment
- Rotable equipment and components that can be replaced in modules and repaired under workshop conditions as far as possible

5.7. ACCESS REQUIREMENTS

Access for all maintenance tasks shall be provided in accordance with requirements of AS 4024.3610 and AS 1657.

All platforms, ladders and handrails are to comply with AS 1657 and give adequate means of operation, inspection and overhaul purposes and shall be of sufficient strength to support workmen, tools and portions of plant which may be placed on them during overhaul and inspection periods. Particular attention shall be given to their rigidity. Ladders are not preferred and shall only be used when approved by MWPA.

Properly constructed and certified scaffolding may be used to provide temporary access.

5.8. CONVEYOR COMPONENTS

5.8.1. PULLEYS

Wherever possible, pulleys shall be interchangeable with pulleys existing on site. Where this is not possible, and new pulley designs need to be introduced the pulleys shall meet the pulley supplier's selection criteria with respect to deflection and loading and shall conform to the requirements below.

Non-drive pulleys with shafts less than 200 mm at the hubs shall have turbine style end discs with Ringfeder 7012 or equivalent locking elements. Drive pulleys and pulleys with shafts 200 mm and larger shall be T-bottom style pulleys with Ringfeder 7015.1 or equivalent locking elements.

Pulley diameters shall be in accordance with the belting manufacturer's recommendation. Pulley face widths shall be sized as follows:

- Belts up to 650 mm wide, face pulley width shall be 100 mm wider than the belt
- Belts over 750 mm to 1400 mm wide, face pulley width shall be 150 mm wider than the belt
- Belts over 1400 mm wide, face pulley width shall be 200 mm wider than the belt

Pulley diameter is to be selected with due consideration given to:

- Belt thickness and number of plies
- Tension on the belt with respect to the tension rating for the belt
- Duty of the pulley (drive, driven or snub)
- The belt manufacturer's specified minimum pulley diameter

The following pulley profiles and details shall be followed unless otherwise specified:

- Pulleys for use with steel cord belting shall have a flat profile
- Head and tail pulleys for use with fabric reinforced belting shall be crowned
- In general, pulleys shall have live shafts and shall rotate in anti-friction bearings
- For small, in-plant conveyors, pulleys with in board bearings may be considered when there is a specific advantage (e.g. narrower overall width)
- Shafts shall not be welded

The pulleys shall be constructed from fully welded steel (excluding shaft). The pulley shall be designed for infinite fatigue life based on the application of maximum running load and maximum momentary loads during starting and braking. The design shall also take into consideration the possibility of increased loads due to the motor stall torque being applied to the pulley.

SHAFTS

Shafts shall be designed considering maximum tensions for worst case running conditions, as well as maximum instantaneous loads. As a minimum the shafts will be designed in accordance with AS 1403. The manufacture of drive pulley shafts shall be with AS 1444-4140 or AS 1442-K1045 steel. The manufacture of non-drive pulley shafts shall be with AS 1442- K1045 or 1040 steel.

Pulley shafts shall incorporate the following details:

- Surface finish on shafts to be 3.2 microns (UON drawings)
- Shaft concentricity tolerance to be 0.05 mm
- Drive shaft extensions to suit requirements (extension length, diameter, fit, keyways etc.) of gearbox or low speed coupling
- Shaft deflection at the locking element should be less than 0.0015 radians
- The end of the drive shafts extension, or extensions for low speed holdbacks shall have a central M16 hole drilled and tapped to assist with installation and removal of the drive units, low speed coupling or holdback

Changes in shaft diameter shall be achieved in a manner which limits stress concentration. The diameter of the shaft at the bearing shall not be less than 60% of the shaft diameter at the locking assembly.

SHELLS

General pulley shell design criteria;

- Maximum allowable shell design stress shall be 55 MPa during normal operation
- The shell thickness shall be at least 10mm. Extra strong line pipe may be used where the shell design thickness is 10 mm
- Total indicated run out on shell outer steel surface shall be 0.75 mm
- Difference in diameter measured at opposite ends of the shell 0.8 mm per 1000 mm of face width
- Rolled steel shell material to comply with AS 3678 1990 Grade 250
- Rolled shell concentricity tolerance shall be +/-3 mm
- Shell outer steel surface shall be machined at least 85 %
- Shell surface finish shall be 6.4 micron

Pulleys crowning shall be on the outer thirds of the shell as follows;

- Crowning shall be 2 mm on shell thickness where the shell is from line pipe
- Crowning shall be 3 mm on shell thickness where the shell is from rolled plate
- Crowning shall be machined on steel shell

END DISCS

End discs shall be fabricated from a single piece of AS 3678 1998 Grade 250 Steel.

- End disc outer radius to have AS 1210 'J' type preparation for full penetration welding to shell
- Maximum allowable end disc design stress to be 55 MPa during normal operation

LAGGING

Rubber lagging is preferred on all pulleys, however, ceramic lagging shall be used when a higher coefficient of friction is required.

Rubber to metal adhesion shall not be less than 9 N/mm2 and shall be tested in accordance with AS 1683.14. The lagging shall be hot vulcanised. Total indicated runout (TIR) over lagging to be less than 1.5 mm.

Lagging rubber to be grade M rubber with a diamond groove pattern and a Shore Hardness of:

- Drive pulleys (steel cord belts) 70
- Drive pulleys (fabric belts) 60
- Non drive pulleys 50

Ceramic tiles embedded in rubber lagging are preferred for ceramic lagging.

Lagging is to be 12 mm thick.

BALANCING

Pulleys to be statically balanced to 3.0 Nm after lagging

HEAT TREATMENT

Pulleys shell assemblies are to be heat treated for stress relieving of welds to AS 1210-1989.

WELDING

Welds to be full penetration conforming to AS 1554-SP.

ULTRASONIC TESTING

Ultrasonically test welds on shell and end discs shall be performed according to the following standards;

- Shell / disc plate: AS 1710 1986 Level 3E
- Shaft: AS 1065 1988 Acceptance Level HE003 (PS03)
- Circ. weld / long' weld AS 1554 Pt. 1 – SP 1995 AS 2207 Level 2 1994 Min shell AS 2452.3 1985

PLUMBER BLOCKS AND BEARINGS

Pulley bearings shall have a minimum unadjusted bearing life 60,000 hours.

Pulley bearings shall be double row spherical roller self-aligning type mounted on adaptor sleeves.

For general applications, housings shall be manufactured from high grade cast iron in accordance with AS 1830. For special applications, spheroidal graphite cast iron to AS 1831 or cast steel to AS 2074 shall be used where specified. Split bearing housings shall comply with IS0 113/11.

Bearing housings, cap bolts and hold down bolts shall be designed to safely sustain the peak belt tension forces applied parallel to the base of the housing.

Bearing housings shall be installed such that the cap bolts are not under tensile load.

Bearing housings shall be fitted with taconite shaft seals.

PACKAGING AND TRANSPORT

Pulleys shall be supplied with their own frame to prevent damage, including brinelling, during transport and storage.

5.8.2. IDLERS

GENERAL

Idlers shall incorporate labyrinth seals and anti-corrosive seal elements and end covers. Welding on frames shall be to AS 1554 GP.

Three roll 35^o troughing idlers shall be used away from loading points on all conveyors except on belt feeders where 20^o troughing, picking, or bespoke design idlers, may be used.

Return idlers shall be straight type for all belts 900 mm wide or less. Vee return idlers (10 degree vee return idlers shall be used on all belts wider than 900 mm. To reduce dust, the first 10 return idlers after the head pulley shall be rubber lagged using 6 mm thick rubber by hot vulcanising.

Idlers at load points shall be spaced at not more than 300 mm centres.

IDLER SELECTION

The idlers shall be selected so that the idler can handle both static and dynamic loads.

Idler roller selection shall allow for a vertical misalignment of 3 mm between adjacent idlers on the carry side, and 6 mm on the return side. Vertical deflection checking shall be required.

Idlers positioned on convex curves are subjected to higher loads than idlers on nominally straight belt lines. Conveyors with convex curves shall include this load in the idler selection. The idler manufacturer's recommendation must be considered in the selection of the final class of idler.

The following idlers are to be used unless otherwise specified:

Carry Idlers:

- Plain steel equal rolls
- 35^{o} trough
- Offset idlers shall be used unless otherwise specified. Inline idlers shall be used on reversible conveyors

Return Idlers:

- Plain steel equal rolls
- Flat or 10^{o} Vee

Tracking Idlers:

- Training idlers are not to be used
- Inverted 10^{o} Vee shall be used for tracking and positioned prior to the tail pulley

IDLER SPACING

Idler spacing shall be determined according to the following factors;

- Belt manufacturer recommendation on typical idler spacing ranges for a given belt width and material properties
- Limit the belt sag to the criteria specified in these guidelines
- Dynamic and static load on each idler (decrease in spacing distance decreases required grade of idler)
- In determining return idler spacing, minimisation of transverse vibration of the belt shall be considered
- Bearing life

IDLER FRAMES

When new idler frames are installed in skirted areas, these shall be retractable.

5.8.3. BELTING

STANDARDS

All conveyor belts shall be manufactured to meet the requirements of the latest editions of the relevant Australian Standards.

TESTING

The belting shall be tested in accordance with AS 1334-1 to 11 inclusive (or as amended). Abrasion tests to AS 1683 Method 21.

All rolls of belting to be tested. Number of samples to be as per AS 1331, AS 1332 and AS 1333 except that one sample is required for rolls less than 150 m.

The Contractor shall supply completed Test Certificates for each roll of belting. All testing to be carried out on equipment certified by an approved testing authority to the satisfaction of MWPA.

GENERAL REQUIREMENTS

The belting selected shall be adequate for sustaining material load and shall ensure good 'troughability' for empty and loaded belt conditions. The belt selection shall also take into consideration the imposed impact load at the conveyor transfer points. Special care shall be exercised in belt selection for conveyors with vertical curves to ensure belting adaptability to the designed conveyor radii.

The belt breaking strength selection shall be based on the maximum running tension under design load condition.

The minimum belt safety factors shall be:

- Fabric Belts 10
- Steel Cord 6.7

The following factors shall be considered when selecting conveyor belts:

- The maximum accelerating or braking tension shall not exceed 150% of the rated tensile capability
- The maximum edge tension at convex curves and the maximum centre tension at concave curves shall not exceed the following values:
    - When operating - 105% of the rated tensile capability
    - When accelerating or braking - 160% of the rated tensile capability

The minimum centre tension at convex curves and the minimum edge tension at concave curves shall not be less than the following values:

- When operating – 5% of the rated tensile capability
- When accelerating or braking – 2.5% of the rated tensile capability

COVERS

The belting cover materials shall be selected based on the application with consideration given to the following parameters:

- Exposed temperatures
- Resistance to oils
- Weathering
- Impact and gouging due to lump size
- Cutting and abrasion due to sharpness of the material conveyed
- Resistance of cover materials to chemical properties of materials conveyed
- Time taken by the belt to make one revolution

The cover materials recommended for general usage (-30 ⁰C to 70 ⁰C) at sites are:

- Grade M — Toughest service where large abrasive lumps are handled. Resists cutting and gouging. (ROM, primary crushed ore) for product size > 40 mm
- Grade SAR-A — Fine materials < 40 mm

5.8.4. DRIVE UNITS

GENERAL

Refer to **MWPA300 – Mechanical Engineering Guidelines** for gearing and bearing information including L10 bearing life.

Driving pulleys shall be located such that the clean side of the belt is in contact with the driving pulley. Drives shall not be located directly below conveyor transfer points or other areas of possible ore spillage or wash down water.

Shaft mounted drive assemblies are preferred comprising: motor, high speed coupling, brakes (if applicable), reducer, low speed coupling (if applicable), guards, and sub-base and torque arm linkage.

HOLDBACKS

Holdbacks shall be fitted to all conveyors where the runback force due to material on the inclined sections of the conveyor exceeds 50% of the belt friction force excluding skirting friction.

Holdbacks may be of the high speed type installed on an extension of the speed reducer intermediate or high speed shaft or of the slow speed type installed on the drive pulley shaft. For bevel helical speed reducers, holdbacks shall not be fitted to the high speed input shaft.

Holdbacks shall be capable of operating 10 times per hour and 3 times in direct succession. Holdbacks shall be capable of withstanding the full elastic spring back torque of the stalled conveyor drive motor.

The torque rating of the holdback shall not be less than 3 x the rated motor torque. Where multiple drives are installed, high speed holdbacks shall be load sharing.

GEAR REDUCERS

Gear reducers shall be of the helical or bevel helical type unless otherwise specified. The mechanical power rating of each gearbox shall be equal to the demand power multiplied by a nominal service factor of 1.7.

The connection between shaft-mounted gearboxes and associated shafts shall be designed for ready separation of the shaft and the gearbox.

Hollow shaft reducers shall be mounted on the drive shaft in accordance with the reducer manufacturer's requirements and shall transmit the reducer output torque to the driven shaft through a shrink disc connection or equivalent mounted on the outboard side of the reducer.

Alternatively, speed reducers having a spiggoted rigid output coupling bolted to a matching rigid coupling half on the driven shaft may be used to simplify drive installation and removal or to avoid drawing a hollow shaft reducer off its shaft in the field.

Torque arms shall be designed to accommodate drive / coupling misalignment.

The thermal rating shall be based on ambient maximum and minimum temperatures as stated in **MWPA300 – Mechanical Engineering Guidelines.**

HIGH SPEED COUPLINGS

High speed couplings shall be radially, axially and angularly flexible.

Where brake discs are fitted to high speed couplings, they shall be fitted to the speed reducer side of the coupling.

Couplings fitted with flexible elements shall have these removable from the coupling without requiring disassembly of other drive components.

FLUID COUPLINGS

Fluid couplings are used to control the initial starting tension on belt and torque on the motor by offering soft start characteristics

Fluid couplings shall generally be either the traction or delay fill type and shall be capable of bi-directional rotation.

The maximum torque transmitted to the drive pulley during the acceleration period shall not exceed 140% of the full load torque of the drive motor.

When running at full load conditions with the specified oil level, the coupling slip shall not exceed 3%. All fluid couplings shall be selected so that they will be capable of starting the fully loaded conveyor 3 times in direct succession, plus as many evenly spaced starts per hour as would be applicable to the anticipated duty but not less than a total of 10 starts/hour without the fluid temperature exceeding the manufacturer's recommended maximum temperature. For the above selection condition, it shall be assumed that the coupling has been running at full load and has attained its operating temperature.

All couplings shall be fitted with a built-in fusible plug set at 20 ^{o}C above the control setting.

Fluid coupling guards shall be manufactured using plate and not grating. Where fluid couplings are installed, drive unit bases shall be capable of containing the fluid volume when coupling is full.

BELT DRIVES

Belt drives are generally not preferred in conveyors. When installed, belt drives shall be designed to transmit the maximum motor starting torque without slip. The design of drives shall be in accordance with AS 2784. Service factors at least to the manufacturer's recommendation, or a minimum of 2.0 shall be applied to the rated drive motor power.

Pulley/shaft loadings shall be within the motor and reducer manufacturer's recommendations. Adjustment shall be provided to maintain correct belt tension.

Only SPA, SPB or SPC wedge belt drives shall be used.

The maximum drive ratio shall be 2:1. Drive ratios shall be such that standard stock pulleys are used wherever possible.

The maximum number of individual belts per drive shall be five (5) and a minimum of two (2).

BRAKES

When the normal stopping time of a conveyor would exceed 10 seconds under any condition from empty to fully loaded then a brake shall be considered to reduce the stopping time to no more than 10 seconds (if practicable). The brake shall be selected to stop the conveyor under the most adverse condition of loading. The brake may be located on the drive unit, or if design considerations require – a low speed brake may be located on a suitable non-drive pulley.

Brakes shall be selected such that when applying their rated torque, slip will not occur at the brake pulley under any design load conditions.

Brakes shall have a torque rating of at least 150% of the specified braking torque of the conveyor.

Brakes used as a holdback shall also comply with the torque rating specifications for holdbacks.

In general, disc brakes are preferred. Provision of drum brakes to be approved by MWPA.

Disc brakes shall be of the spring applied, hydraulic released type and fail safe in operation, complete with callipers and hydraulic system.

Drum brakes shall be of the spring or counterweight applied, electrohydraulic thruster released type and fail safe in operation.

Brake discs and drums shall be capable of dissipating the energy released by stopping the conveyor 10 times per hour and 3 times in direct succession.

DRIVE BASES

Drive bases for hollow shaft reducers or spiggoted bolted rigid coupling drives shall incorporate the reducer mounting, motor base, brake base if applicable, and include provision for mounting the drive coupling guards and torque arm connection.

For hollow shaft reducers, the drive base must also act as a torque arm and as such shall be designed to transmit 2.5 x motor full load torque. The base must be adequately anchored to a structural member to resist the applied torque in both clockwise and anticlockwise directions using a single point connection.

Torque arms are to be in compression if possible. If torque arms are in tension, a safety chain or similar redundant positive restraint shall be installed to prevent the drive rotating should the torque arm fail.

Bases shall be designed to limit deflections at the high speed coupling faces to not more than 50% of the coupling manufacturer's recommended alignment tolerances at the maximum combination of static and dynamic loading.

5.8.5. SKIRTING

Skirt boards shall be continuous when several loading points are close together on the belt. Skirt rubber shall be selected to be softer than the belting cover material. Skirting shall be held in position with an angle and wedges used as locking devices.

Proprietary skirting systems may be provided if approved by MWPA.

Unless otherwise specified, the skirt length shall be three times the belt width beyond the loading point on belts handling dry material. Cover plates shall be fitted to the skirted section, and dust hoods provided to connect to the dust collection system.

5.8.6. BELT CLEANERS

It is intended that primary and secondary belt scrapers shall be fitted at the head and tripper pulleys of all conveyors. Secondary scrapers for reversible belts shall be the inline type, suitable for reversing belt operation. Scrapers shall be adjustable from outside the head chute.

A hinged 'V' plough scraper shall be located above the return strand ahead of all pulleys on the return belt. The width of this scraper shall be belt width plus 150 mm. For reversible belts a diagonal plough shall be used.

5.8.7. GUARDS

Conveyors shall be guarded to meet the requirements of AS 4024. Removable guards need to be removable by one person to safe lifting requirements. Specialised equipment should not be required to remove guards.

New guards shall be interlocked to prevent conveyor operation when removed.

5.8.8. TAKE-UP

Screw take-up systems may be used on conveyors less than 40 m long.

In all other cases, conveyor take-ups shall be of the gravity type. The length of travel of take-ups shall be designed to accommodate the making of at least one subsequent maintenance belt splice without the need to insert belting, as well as accommodating permanent and dynamic elongations, clearances on either end of the travel. Take-up travel shall not be less than 2.5% of conveyor centre distance for fabric belts and 0.5% for steel cord belts.

Take-up systems shall be kept as simple as possible. Gravity weights shall be a combination of concrete and steel plate where applicable.

The theoretical take-up weight shall provide the required working tension. Where practical, provision shall also be made for the addition of an extra 15% over and above the theoretical weight using steel plates. Refer Section 5.4 for detailed information.

New vertical gravity take-ups (festoon take-ups) shall be fitted with a rope and winch system to allow for the take-up tension to be safely removed for maintenance. The winch rope shall have a counterweight to maintain tension in the rope during operation.

Take-ups shall not be positioned under feed or transfer points or anywhere susceptible to spillage from other parts of the plant.

6. TRANSFER CHUTES

6.1. DEVELOPMENT OF A BASIS OF DESIGN

All new transfer chutes shall incorporate the following design features:

- Access doors, hinged to swing horizontally and latched.
- Rock boxes (where applicable) or other devices such as impact plates to suitably direct material onto receiving conveyor.
- Wherever practicable a minimum valley angle of 60^o to the horizontal. If flow property information is available, then that flow property data must be used. Chute backplates that collect dribble from the scraper shall have a minimum valley angle of 70^o.
- Head chutes shall be split horizontally near the centre line of the pulley shaft to allow removal of the top portion of the chute for ease of pulley replacement.
- Head chutes shall be designed such that scrapings from the head pulley scrapers fall within the chute.
- Adequate space shall be provided in the head chute to accommodate primary and secondary scrapers.

The chute shall be designed based on the surge capacity of the related conveyor and the supporting steelwork shall be designed to withstand blocked chute conditions. Chute profiles shall be suitable for the characteristics of the material, shall be self-cleaning and provide smooth transfer with minimum wear.

The discharge trajectory of the material from the conveyor drive shall be the basis for the discharge chute design. The Dunlop method will be used to determine the material discharge path.

6.2. ANALYSIS AND DEM MODELLING

Where chute geometry has been modified, or new geometry is introduced, analysis may be undertaken as part of the design phase to optimise material flow and minimise wear within the chute. The mechanical engineer shall assess the significance, complexity, and risk associated with the modifications and determine if analysis is required.

The two (2) industry-practiced methods of material flow analysis are:

- Discrete Element Method (DEM) Modelling
- Single Trajectory Calculations (Numerical Analysis)

6.2.1. DISCRETE ELEMENT METHOD (DEM) MODELLING

DEM Modelling allows a 3D visual representation of the material flow through a transfer chute – highlighting areas of concentrated wear and material choking. This is achieved by modelling the movement and interactions of individual particles. DEM can provide a good indication of comparative performance between design alterations and effectiveness of proposed modifications. (i.e. rock box, deflector plates etc.).

As there is an effective limit to the smallest particle size modelled, DEM is better suited to modelling flows containing larger particles. DEM is not suited to the modelling of scraper dribble.

It is recommended that DEM should be the preferred method of chute analysis if:

- An existing 3D model of the current chute exists – or if providing a 3D model of the chute is included as part of the contractor's scope
- Detailed visualisation of material and wear profiles through the chute is required
- Presentation of chute concept is required for stakeholder engagements
- The chute has complex geometric requirements (e.g. curved chutes, chutes with multiple rock boxes, bifurcating chutes etc.)

The accuracy of DEM results depend on calibrating internal parameters to correctly model cohesion and wall friction.

For DEM modelling to be successful, consideration must be given to the following:

- Selection of material parameters that represent the upper and lower limits of internal friction angles, wall friction angles, angle of repose and limits to size and shape of modelled particles
- Calibrating the model to properly represent the chute and materials

The mechanical engineer (or project manager) shall decide if the use of DEM modelling is beneficial to the project and design analysis.

6.2.2. SINGLE TRAJECTORY CALCULATIONS

If DEM modelling is not to be used as a method of chute analysis, numerical analysis of material flow shall be required as a minimum.

This method follows a single trajectory through the chute starting at the conveyor pulley discharge. This method is relatively inexpensive, however provides limited insight to the material flow.

To assess material trajectory from the head pulley, a CEMA-recognized numerical method shall be used as per industry practice.

The contractor or party undertaking chute design or modification shall submit all calculations as part of the deliverables package.

6.3. LINER SELECTION AND DESIGN GUIDELINES

A general guide for the design and installation of liners is as follows. These factors should be considered when selecting and designing liners for interior chute lining:

- Liners should only be applied to areas that are expected to experience wear within a chute
- Standardised liner sizes or drop in liner units shall be used whenever possible
- Liner size to suit handling method and access
- Liners, which require manhandling, should weigh no more than 20 kg
- Thickness to suit application and material, minimum 12 mm

- Philosophy is to line with acceptable quality and thickness to achieve at least 4 – 6 months life, once areas of intense wear are determined use higher quality liner material of same thickness in these areas
- Cast or rolled liner material is acceptable
- All liners shall be fixed at a minimum of two places by bolting or plug welding depending on expected life
- Stud welding the fasteners to the liner is the preferred method
- Bolt holes in liners shall be countersunk so that bolt heads are at least 6 mm below the wear surface
- On fines chutes related to conveyor scrapers use UHMWPE or stainless steel (polished to a 2B finish), 3 to 6 mm thickness
- Pay attention to corner design to limit build up and permit removal of liners

6.4. BLOCKED CHUTES AND OVERFILLED BINS

The load from blocked chutes and overfilled bins shall be computed from the maximum expected bulk density of the materials and the volume of the chute or bin.

For simple chutes, vertical loads on the belt or feeder below and pull out forces can be determined by an appropriate method (hydrostatic, Bruff's method, Robert's method or the CEMA method).

For bins AS 3774 shall be used for to determine loads on belts or feeders below.

For column design, the simultaneous effect of live load on other floors need not be considered with the blocked chute load.

Loads that might be categorised as abnormal include:

- Conveyor or feeder drives stall condition at maximum possible torque
- Bins and chutes filled with ore and which are flooded with water
- Blocked chutes
- Ore spillage
- Vehicle impact

7. SHIPLOADERS

This section provides guidelines for upgrade and component replacement projects related to the shiploader.

7.1. RELATED WORK PROCEDURES / REFERENCES

The following MWPA safe work procedures (SWP), procedures, and related documents are applicable to the operation and maintenance of the shiploader. When applicable, these documents should be read in conjunction with this document.

- LSO-SWP-020 Positioning and Loading – Berth 4 Shiploader
- LSO-SWP-021 Positioning and Loading – Berth 5 Shiploader
- AMSA Marine Orders Part 34, Issue 6 - Solid Bulk Cargoes
- Code of Practice for the Safe Loading and Unloading of Bulk Carriers (BLU Code)
- Vessel / Shore Safety Checklist
- Vessel load plan
- LSO-SWP-004 Shiploading Communications Berth 4 & 5 and BHF
- HSE-PRO-033 Isolation and Tagging Procedure
- HSE-PRO-014 Loading Metal Concentrates
- LSO-SWP-020/FRM02 BHF Shiploader Pre-Start Check List

7.2. DESIGN PARAMETERS

Any modification to the shiploader shall be designed to the standard AS 4324.1 to meet the expected remaining life of the shiploader. For mechanical equipment the expected life is to be at least 15 years. In addition, the following design criteria applies:

- A production time greater than 50% of design life
- Overall Machine availability (Maintenance Effectiveness) of 95%
- Improve maintainability and safety
- Minimise operation costs
- Operate and maintain plant in accordance with ergonomic principles

7.3. UPDATING OF MACHINE BOOK

As part of the overall risk management plans, the machine book must be updated to capture changes – refer to Section 7.6.4.

7.4. DESIGN VERIFICATION

Verification of the shiploader structural and mechanical design shall be required if new designs or modifications are deemed to result in significant changes to previous load distributions on the system.

Design verification may not be required if new design or modification works do not result in any evident variations in load distribution. It shall be the responsibility of the MWPA Engineer to determine if such verifications are required as part of modification works.

7.5. SHIPLOADER COMPONENTS

All mechanical components shall be in accordance with **MWPA300 – Mechanical Engineering Guidelines** where applicable. The existing shiploaders are luffing / shuttling shiploaders with long travel capability, and dual and redundant luffing winches.

7.5.1. WINCHES

The following guidelines are intended to provide guidance for luffing winch replacement projects, where the luffing winch needs to be upgraded due to increased loads, increased operational speeds. Where a winch is replaced for end-of-service-life reasons, like for like replacement may be considered.

The winch and ropes shall conform to all requirements of AS 1418 and AS 4324.1. The rope winch system shall comprise dual rope drums supported in separate bearings and individual fail safe disk brakes for each drum. The degree of protection for all mechanical equipment shall be a minimum of IP 65. Dual drums shall be mechanically connected. Load sharing between the ropes shall be achieved by means of an equalising beam or other approved load sharing mechanism.

Any works associated with the luffing function of the shiploader shall maintain the current luffing speeds of the shiploader – unless otherwise approved by MWPA.

WINCH DRUMS

The winch drum should be machined with spiral grooves for the wire rope.

The drum length shall accommodate all of the specified rope capacity and two dead turns of wire rope in the specified number of layers. Where the maximum drum length is limited due to external constraints the drum diameter shall be increased to accommodate the length of rope. Where more than two layers are proposed, approval from MWPA is required.

Drum diameter shall not be less than 18 times the diameter of the steel wire rope.

The drum shall be finished smooth and shall be free from defects likely to damage the wire rope.

Drum shell thickness beneath the grooves shall be at least as thick as the wire rope diameter and checked for strength. In addition, a minimum of one full wrap shall be provided to accommodate rope stretch.

The drum shall have end flanges that extend radially sufficiently to ensure that rope is contained and is at least two rope diameters more than the outside of the rope when it is in the outside layer.

Drum and sheave design shall accommodate both metric and equivalent US sized wire rope.

WINCH ROPES

Worn or damaged ropes are to be replaced with like-for-like ropes. If as a result of upgrading or modifying the shiploader it is necessary to meet the requirements of AS 4324.1, rope diameters or grade may need to be increased.

Wire ropes shall comply with AS 3569. The rope and end fittings shall be subject to test requirements in accordance with AS 3569 and AS 1418.

The wire ropes shall be two independent redundant sets of wire rope reeving, one for each winch drum.

The ropes are to comply with all requirements of AS 4324.1.

Rope certificates shall be provided with all ropes.

Ropes shall have a suitable lubricant dressing incorporated during manufacture which shall serve as corrosion protection and internal lubricant.

Wire rope should be extra-improved plow steel with independent wire rope core supplied pre-lubricated, internally and externally by an approved wire rope manufacturer. Wire rope shall be inspected and tested by an independent testing laboratory.

Hardwood or synthetic buffers shall be provided for protection of wire rope at all points where contact with the shiploader structure could occur.

Steel wire rope that is kept in storage as a critical spare should be stored in accordance with the manufacturer's recommendation and at a minimum kept in cool dry place and should be placed on pallets, not the floor. Air tight transport wrapping should be removed.

WINCH DRIVE

Drive Assemblies shall be suitable for the nominated duty with the capacity to stop and start under full load conditions. The drive shall be able to support 50 starts in direct succession and at least 150 equally spaced full load starts per hour.

Winch motors shall be controlled via variable speed drives (VSDs).

The winch drive shall be designed for continuous repeated start-stop operations. Drive motors shall be rated for 415 voltage supply. The drive unit shall be fitted with a high speed brake.

MWPA shall specify the luffing speed of pony drive if such drives are required. Pony drives will be fitted with manually operated dog clutch with proximity sensors to confirm both engaged and disengaged positions, which shall be integrated into the control systems.

SHEAVES

All sheaves should be manufactured from spheroidal graphite iron and shall be complete with antifriction bearing seals and close fitting rope guards to prevent the rope coming off the sheave. The diameter of the sheaves at the bottom of the groove shall comply with the requirements of AS 1418.

All parts of the reeving system shall be designed to withstand motor stall and maximum brake torque without exceeding 75% of the yield of the material used.

Tolerances shall be indicated and gauges shall be provided to indicate worn out sheaves. In addition, the Contractor shall recommend repair/replacement methods and periods to ensure safe operation.

Sheaves and sheave bearings within a system shall be interchangeable.

Sheave design shall accommodate both metric and equivalent US sized wire rope. Rope flanges of adequate thickness shall be provided at the ends of the drums. The flanges shall protrude radially not less than two (2) wire rope diameters above the top of the wire rope.

For works where rope diameter remains unchanged, replacement sheaves shall be compatible to fit with existing sheave bearing housings and supports.

Sheaves at a common location shall be fitted with lubrication lines to a single accessible manifold.

LOW AND HIGH SPEED BRAKES

The low and high speed brakes should be fail-safe type with hydraulic release, spring applied type actuation and with facilities for adjusting the brake torque.

The high speed brake(s) should be working brake, engaging during luff winch operations. The high speed brake(s) shall be able to support 50 operations in direct succession and at least 150 equally spaced full load operations per hour.

The low speed brake shall be set on a timer from last luff winch operation to engage. The low speed brake shall be able to support 30 equally spaced operations per hour.

Brake thermal capacity shall be adequately assessed for the selected application to ensure sufficient capacity.

Brakes callipers shall allow for lateral movement of the disc due to thermal or mechanical causes.

7.5.2. LONG TRAVEL DRIVES

Any works associated with the long travel function of the shiploader shall maintain the current long travel speeds of the shiploader – unless otherwise approved by MWPA.

Long travel drives shall be capable of driving the machine at ship unloading speed and re-positioning speed in both directions. The drives and brakes shall be capable of smooth acceleration and deceleration so that shocks, shudders and oscillations are not induced in the structure.

Sufficient drives shall be installed so that the machine will have adequate traction for drive and braking under the most adverse conditions of head wind, rail slope, yard belt operation and boom position with operational load, at the minimum wheel/rail coefficient of friction specified in the standard. The drives shall be evenly distributed on either rail to minimise misalignment forces and crabbing.

7.5.3. CABLE REELERS

Cable reelers shall be designed to maintain the cable tension within the limits specified by the cable manufacturer. Where the shiploader speed is increased for any reason, the cable reeler should be checked for adequacy.

7.5.4. BUFFERS

Energy absorbing buffers are required to bring the machine to rest. Should machine parameters change (speed, mass, load distribution, etc.) the adequacy of the buffers should be assessed. The buffers shall be capable of absorbing the kinetic energy of the machine at maximum speed including the rotational inertia of the drives and the work done by the drives over the buffer stroke in bringing the machine to rest. The drives shall be considered as fully engaged. The maximum force applied by the drive inertia and drive power, is limited by the maximum wheel/rail friction that is specified in the standard.

The bogies or machine structure where the buffers impact shall be designed to resist this force. The shiploader shall be checked to ensure it can safely resist the specified maximum end force.

7.5.5. RAIL CLAMPS AND STORM PARKING

The machine is provided with rail clamps and storm parking. If the machine parameters are modified such that the wind loads are expected to increase, these components should be checked for adequacy.

Rail clamps shall operate only when the ship loader is at rest. The long travel drives shall be interlocked with the rail clamps so that drive will not occur until the clamps are released. An indication of the rail clamps position (on or released) shall be provided. The rail clamps shall operate automatically after an adjustable delay from the time the ship unloader is brought to rest.

7.6. GUIDELINES FOR RISK MANAGEMENT ACTIVITIES FOR SHIPLOADERS

7.6.1. RISK MANAGEMENT PLAN

A risk management plan based on risk assessment outcomes as envisaged in AS 4324.1 is to be maintained for each machine. The risk management plan should as a minimum address the following:

- Condition assessment updates
- Design modifications
- Structural integrity audits
- Changes to operating or maintenance conditions

7.6.2. CERTIFICATION REQUIREMENTS AS ASSET OWNER

Although shiploaders are not regarded as classified plant according to DMIRS definitions, the minimum requirements for classified plant (with respect to record keeping, risk management, inspections, and maintenance) should be followed.

7.6.3. MACHINE WEIGHING

It is recommended that machine weighing be undertaken following any modification works that may introduce additional weight exceeding 5% of the original shiploader design weight. AS 4324.1 stipulates that re-analysis of the shiploader structure and equipment is required if weights exceed this limit.

7.6.4. MACHINE BOOKS

A machine book shall be maintained for all shiploaders so as to ensure that all drawings, design details, operating details, control philosophies and equipment lists are current, and that the risk management plan is reviewed and updated on a regular basis and prior to any significant change to the shiploader. The machine book shall contain the latest revisions of:

- GA drawings of the shiploaders
- GA drawings of all major equipment
- Electrical drawings
- Machine Risk Management Plan (MRMP) and risk register
- Functional description
- Maintenance instructions and procedures

The MWPA project representative shall provide the contractor with a copy of the native version of the shiploader machine book prior to any modification works commencing.

The native version of the machine book shall be updated as soon as additions, changes, deletes and inspection/audits occur to the machine. Updates to the machine book shall be included in the scope of any shiploader modification project.

7.6.5. CONDITION ASSESSMENT AND STRUCTURAL INTEGRITY AUDITS

The focus of the future MRMP audit/inspections is to assess the status and risk profile of those components whose deterioration could lead to catastrophic collapse of the machine. This failure modes and effects approach must scrutinise deterioration where there is no redundancy to protect against collapse.

To assist in the determination of machine condition, all previous reports and audit data should be clearly documented and referenced as part of audit requirements.

Condition assessment of the shiploader structure – in particular NDT of key member thickness – shall be required should any modification work be undertaken that may introduce increased loads on these structural members of the shiploader. Attention shall be given in particular to members that may be prone to concentrated internal corrosion (i.e. not sealed or observed to have inadequate drainage).

As part of structural integrity auditing, the following systems within the shiploader shall be audited and assessed as a minimum:

1. Long Travel System
    a. Buffer stops
    b. Drive system
    c. Clamps and storm tie-downs
    d. Brakes
2. Luffing System
    a. Ropes (refer to AS 4812 for guidance on Non-Destructive Testing of steel wire ropes)
    b. Sheaving
    c. Winch drums
    d. Drive system
    e. High and low speed brakes
    f. Load equalisation system
3. Shuttling System
    a. Drive system
    b. Limit switches
    c. Rails
4. Telescopic Chute and all other attachments
5. Electrical and control systems

7.6.6. RISK ASSESSMENT OF OPERATION AND TESTING OF PROTECTIVE DEVICES

A formal procedure shall be in place for the recording of functionality of final limits. Current practices should be as follows:

1. Take the machine action through its operating limit
2. Visually confirm that the final limit striker will engage the sensor arm
3. Test the final limit manually to conform electrical functionality

It is recommended the above tests be carried out every two months.

7.6.7. DESIGN VERIFICATION

The design of the shiploader should be verified irrespective of modification or upgrade works. This routine verification shall generally consist of showing operating loads have not changed from the current design loads – as opposed to a full design assessment.

Design verification is recommended to be undertaken once every ten (10) years.

8. TOWERS

8.1. GENERAL

The term 'Tower' refers to both transfer and take-up towers for conveyor systems within the BHF.

The contractor or party undertaking tower-related works shall be made aware of the current condition of the tower(s) based on previous structural integrity audits; in particular any areas that may be deemed insufficient to accommodate new works (i.e. areas where condition has deteriorated, or under-designed for the application).

Should design or modification works on towers be deemed to introduce additional loading to the structure, the contractor or party undertaking works shall submit all expected loading on the tower as a result of these works.

Refer **MWPA400 – Maritime Structures Guidelines** for detailed structural requirements of towers.

8.2. ACCESSIBILITY AND MAINTAINABILITY

When installing new bulk handling equipment within towers, or modifying tower design, attention shall be given to the following design criteria:

- Access as required to mechanical equipment for operation, maintenance, and inspection
- Clearance requirements to AS 1428
- Introduced trip hazards as a result of new or modified systems

New or modified equipment within towers shall be located in accessible areas using existing platforms and access ways where possible. The installation of new equipment should not restrict accessibility to existing areas or equipment within the towers.

8.3. DUST GENERATION AND WASHDOWN AT TRANSFER TOWERS

The modification of existing, or installation of new mechanical or bulk handling equipment / infrastructure within towers shall consider dust generation and washdown requirements, and how new systems or modifications may affect current procedures.

All new systems and modification to existing systems shall be designed to facilitate washdown and tie into existing wash water handling systems.

8.4. WORKS ON TAKE-UP TOWERS

Prior to any works being carried out on take-up towers (by MWPA or approved contractors), the conveyor and take-up mechanism associated with the tower shall be isolated.

9. FEEDERS

The following section outlines the current feeders used by MWPA at the BHF. Any works on the feeder shall be a like-for-like replacement unless otherwise specified by MWPA.

Any design or modification works to the feeders on site shall be designed to current operating parameters unless approved by MWPA. It is also recommended that downstream equipment (conveyors, transfer chutes, etc.) be assessed to determine if increased feed rates could pose any risk to this equipment.

The table below highlights the current feeders within the BHF as well as vendor data and operating parameters of each.

Table 9-1: BHF Feeders

Feeder No.	Model (Vendor)	Drawing No.	Feed Rate (tph)	Belt Speed (m/s)	Length (m)	Installed Power (kW)
FD01	Low Profile Feeder (Transmin)	46931-SH1 - 4	3000	0.33	20.183	220
FD03	Truck Unloading Feeder	G3-1010	2000	0.26	35	37

Additional feeders installed on site shall be appropriate for the material handled, and throughput requirements. Preference is for use of feeders that are common or have common components to those already onsite where practical.

10. UNLOADERS

Unloaders are located atop feeders within the BHF.

10.1. Truck Unloader

The truck unloader is a drive over dump hopper above belt feeder FD03. The unloader is enclosed by a dust containing steel structure which is sheeted on the sides and roof.

The unloader is equipped with a hydraulically actuated 'grating' door to allow access into the hopper and for dumping wet or lumpy material as well as a hydraulically adjustable feed gate to control the material discharge height on the feeder.

10.2. Train Unloader

The train unloader allows for the unloading of two wagons simultaneously. The unloader comprises a static grizzly over the feed hopper to Low Profile Feeder FD01. As with the Truck Unloader, the Train Unloader has a dust containing steel structure.

11. DUST EXTRACTORS

11.1. GENERAL

The dust extraction system shall encompass the following systems. As part of baghouse design or modification, these systems shall be assessed:

- Baghouse – access panels, filter bags, reverse pulse system, dump valves
- Ducting (transfer to baghouse) – including balancing plates, baffles, gates
- Safety Guards
- Fan Assembly – belt drive, bearings and housing, fan casing, noise and vibration
- Dust disposal – collection bag, batch hopper, disposal method

11.2. DESIGN PARAMETERS

Reverse pulse baghouses (RPBH) are generally the preferred method of dust collection when looked at from an OHS perspective. This is because RPBH's are the most effective method of removing the respirable particles from the area being treated to ensure occupation dust exposure standards are met.

The dust collection systems incorporating baghouse dust collectors must be designed to extract air-borne dust from the nominated take-off points, convey this air through ductwork to a RPBH Dust Collection System and discharge shall be monitored via level-monitored dump valve for manual or automated removal.

The dust collection systems incorporating reverse pulse baghouse dust collectors must be designed to extract adequate volumes of air / dust from each transfer point to 'as much as practical' levels; in turn eliminating the egress of dust of the transfer of materials from one conveyor to another. This includes assessing airflow velocities and requirements, and if the existing collection points are adequate for site dust collection requirements.

The design must facilitate ease of safe access for handling, transportation, installation, adjustment, control, maintenance and repair. The equipment offered must be of demonstrated design in a comparable application. All materials shall be new and the best quality available for this purpose.

The equipment must be designed to prevent the build-up of product, spillage and dust, and the subsequent potential for corrosion. All equipment shall be designed, sized, manufactured, tested, certified, supplied and commissioned in accordance with the requirements of AS 4100 and AS 1359.30 and all related standards as applicable.

The equipment must be designed to withstand heavy and abrasive dust loads, harsh use by plant personnel, hot and humid conditions, and wash down with hand-held pressurised hoses.

11.3. NEW DUST SYSTEMS

Dust extraction systems shall be suited to the expected materials encountered at the assigned transfer point. The materials applicable to the dust collector must be specified.

All equipment must be of heavy-duty design and suitable for continuous operation at the rated capacity for the duty and minimum design life as specified by MWPA. The minimum design life of baghouses should be twenty (20) years with adequate maintenance procedures.

The expected operating periods for dust collectors on site should be defined by the contractor or approved party undertaking the works – however should be suitable for continuous operation at the rated capacity.

Dust extraction systems, together with other engineering and operational dust management practices are required to maintain dust emissions within the target stipulated in the MWPA Environmental Licence.

11.4. MODIFICATIONS TO EXISTING DUST EXTRACTION UNIT

Where additional transfer points are required to be integrated into the BHF dust extraction system, it may be possible to add dust extraction points to an existing baghouse / unit. Consideration as to whether or not this is acceptable include:

- Fan capacity
- Air velocity in ducting
- Filter capacity to handle increased volume
- Material compatibility with existing baghouse

An alternative to integrating into an existing system is to use an insertable dust collector.

12. PROJECT DELIVERY REQUIREMENTS FOR BULK HANDLING EQUIPMENT

12.1. GENERAL

All new or modified existing mechanical equipment to be installed shall follow a project delivery process which ensures that all aspects and implications of the proposed equipment have been considered prior to implementation.

12.2. PROJECT DELIVERY PROCESS FOR MECHANICAL EQUIPMENT

New mechanical equipment or alterations to existing mechanical equipment being considered for installation within the BHF is required to undergo a structured assessment and delivery process, as below:

1. Problem/Opportunity identification
2. Option/Concept Study: Initial investigation of problem, identification of Options and Concept development for Options (including budget estimates)
3. Presentation of Option study to stakeholders and selection of preferred option
4. Decision by MWPA to proceed/revise proposal and funding application
5. Detailed engineering development for preferred option
6. Design reviews for engineering development, including Safety in Design (SiD) reviews, HAZOP, HAZID
7. Operational readiness planning: Planning and implementing any operational changes or training requirements needed when new equipment is installed (manuals, changes to SCADA system, inspection requirements, spare parts and maintenance documentation for new equipment)
8. Implementation/installation of new equipment
9. Commissioning and testing of new equipment, monitoring run-in period
10. Hand-over of equipment to Operations
11. As-built drawings and documents for any drawings or modifications made to equipment during implementation
12. Close-out project

Depending on the nature of equipment under consideration, the above process may be modified to suit the individual project requirements, with the underlying requirement that a structured and documented delivery process shall be followed.

12.3. SAFETY IN DESIGN

Refer Section 4.8.

12.4. QUALITY ASSURANCE

12.4.1. GENERAL

The Quality Management Plan (QMP) shall set out the individual tests, both destructive and non-destructive, inspections and verifications required to ensure that the materials and plant being manufactured, supplied and constructed meet the requirements of the specification, standards and good manufacturing practice, as regards workmanship, design life and operating conditions in which the plant will be used.

It shall make reference to the particular plant items, the standards and drawings applicable, the stage of manufacture at which tests have been carried out, provision for relative notation as to test certificate number and details of symbols used.

The MWPA Engineer will approve the QMP and reserves the right to witness all the operations of the contractor and subcontractors and to inspect all equipment at any time during and after manufacture.

12.4.2. MANUALS

The following manuals shall be submitted as part of any project undertaken, as a minimum where applicable:

- Installation Manual
- Inspection and Test Plans (ITP)
- Operation and Maintenance (O&M) Manual
- Manufacturers Data Report (MDR)
- Commissioning Reports
- Vendor Equipment Datasheets

12.5. DRAWINGS AND DOCUMENTATION

A preliminary deliverables list should be expected prior to contract award. This should include details of the types of drawings that are expected without necessarily stipulating the number of drawings and drawing titles.

Within two weeks of the contract award on a project, the Contractor shall submit a Deliverables Register, listing all deliverables that will be submitted as part of the Scope of Works for approval by MWPA. The Deliverables Register as a minimum will detail the document number, current revision, title, contractual date, date issued and date approved of all documents. Drafting to be in accordance with MWPA200 Drafting Guidelines and AutoCAD Standards.

On the completion of the design, the Contractor shall provide a complete pack of supporting calculations to MWPA. The calculations shall be sufficiently comprehensive so that they demonstrate that the design is in compliance with the requirements of this specification and the relevant standards.

All calculations shall be carried out and presented in SI units.

12.6. MAINTENANCE OF AS-BUILT DESIGNS AND MODELS

As part of all modification or upgrade works within the BHF – all existing as-built drawings or models associated with the BHF shall be updated to reflect to the new arrangement and condition of the BHF and / or subsystems. In particular, any new or replaced equipment on the BHF shall be highlighted in updated as-built documentation.

This maintenance and updating of design documents shall be assigned to MWPA or the approved contractor undertaking modification works as part of the contractor's scope.

12.7. SCHEDULING

The Contractor shall submit to MWPA for review and approval chronological schedule for design, manufacture, testing, delivery, demolition construction and commissioning works that may be relevant to the project. Any changes that may impact the schedule during the course of the works shall be highlighted as soon as identified.

12.8. COMMISSIONING

The Contractor shall be responsible for the both load, and no-load commissioning and testing of a new or modified system where commissioning is required – as well as personnel staffing for such activities. The extent of commissioning of the system will be limited to the equipment installed as part of the project.

It is recommended commissioning be undertaken directly after installation, and during the same site visit as installation works.

MWPA's operating staff should be made available to assist and become familiar with the new equipment.

The commissioning shall be broken down into the following stages:

1. **Pre-commissioning**: Pre-commissioning involves all checks and tests prior to energising the electrical supply to the machine;
2. **No load commissioning**: No-load commissioning involves all checks and tests after the electrical supply to the machine has been energised and prior to load commissioning with load. Upon completion of the above the Contractor shall operate the machine for training purposes and final no-load commissioning purposes using MWPA's operating and maintenance personnel;
3. **Load commissioning**: Running plant under load increasing incrementally to the rated capacity, as well as confirmation that all electronic and manual displays are accurate, and that operational limit switches function as described in this specification; and
4. **Performance and acceptance testing**: The system will be operated at rated capacity to confirm the machine's rated capacity at the operating conditions and duration specified in this specification and the datasheets.

The timing of the loaded commissioning may be deferred from the time of no-load commissioning due site operations, availability of suitable test material and vessel loading.

12.9. PROJECT CLOSE OUT

At the conclusion of the project, a close-out meeting shall be held involving all relevant parties involved in the design, fabrication, installation, and commissioning of new or modified systems.

12.9.1. PROJECT CLOSE-OUT DOCUMENTATION

All project deliverables received to date shall be cross-referenced with the approved deliverable list submitted at the conclusion of the project.

Both hard and soft copies of deliverables shall be kept on site as reference documentation.

13. GUIDELINES FOR MAINTENANCE OF MATERIALS HANDLING EQUIPMENT

13.1. ROUTINE MAINTENANCE ACTIVITIES

Refer to the relevant Safe Work Procedures (SWP's) for routine maintenance requirements.

13.2. NON-ROUTINE MAINTENANCE ACTIVITIES

13.2.1. SCOPING

Where a required maintenance activity is not classified as 'routine' or expected, or has not been undertaken previously at the port, it shall be escalated to engineering.

As part of this escalation, the works shall be treated as a standalone project, whereas MWPA's project procedures (management, delivery, etc.) shall apply; refer Section 12 for full project procedure requirements. As part of the works being undertaken in conjunction with project procedures, the following requirements apply (where applicable):

- Tendering and contract award
- Budget estimate to complete works
- Documentation associated with the design and verification of modification / maintenance works
- Commissioning of system following maintenance works

13.2.2. RISK MANAGEMENT

Refer to Section 7.6.1 for risk management planning.

To assist in managing risks associated with non-routine works, the contractor or party undertaking the defined works shall submit a proposed work procedure subject to MWPA approval before commencing works. Where possible, the selected contractor should have previous experience relating to the maintenance works required.

Relevant MWPA Safe Work Procedures (SWP's) shall be used as a guide when undertaking work on structures / machines. Where SWP's are not available, the MWPA risk management requirements as per 1.7 RISK MANAGEMENT PROCEDURE shall apply.

13.2.3. RETURN TO SERVICE

Prior to returning the structure / machine to operation, the contractor shall have completed the following requirements including MWPA approval:

- Submission of all relevant design deliverables – refer Section 12.9.1 for full project close-out deliverable requirements
- Commissioning to requirements outlined in Section 12.8

Modifications or repair to any classified plant does not require re-registration – however, before the plant is used again, MWPA shall confirm the work comply with AS 1418 prior to return to service.