Energy Infrastructure Investments

Murraylink Electricity Interconnector

Asset Management Plan

CY2022 to CY2026

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Background

The Asset Management Plan (**AMP**) covers the planning period from 1 January 2022 to 31 December 2026 and is updated and reissued on an annual basis.

The AMP identifies the necessary actions required to optimally manage the Murraylink Electricity Interconnector. A long-term consideration of the integrity of assets is necessary to ensure that they remain fit-for-purpose.

The AMP is written on the basis of the best known information at the time of writing.

Purpose

The purpose of the AMP is to:

- provide a comprehensive understanding of the current management approach relating to the asset, its condition and utilisation;
- identify strategic recommendations for future utilisation;
- provide a platform for approval of work programs; and
- identify specific issues affecting the assets and the proposed remediation for budget consideration.

Health Safety and Environmental

The objective of this AMP is to ensure that a strong focus on safety and reliability is maintained in relation to the operation and management of the Murraylink Electricity Interconnector assets. In developing the operating and maintenance procedures incorporated within the AMP, APA Operations EII Pty Limited (as **Operator**) has considered the approved policies and procedures of APA Group.

Suitable safety management systems are in place and operating to ensure that the risks relating to the operation of all EII assets are effectively managed to keep risks as low as reasonably possible. The APA Group HSE Management System is called 'Safeguard' and provides a framework by which the processes relating to EII's HSE activities are written, approved, issued, communicated, implemented and controlled. Additionally, the management system is also subject to review and improvement to ensure objectives and obligations are continually satisfied.

Reviews

The AMP is reviewed each year to ensure that the content is current.

Changes to the assets will inevitably occur during the life of the AMP. Unless there are issues identified that significantly impact the validity of the plan it is only intended to amend the AMP at each annual review.

Summary of Estimated SIB Capital Expenditure

The following table shows the estimated expenditure on the Murraylink Electricity Interconnector for the period CY2021 to CY2026.

Description	Forecast 2021 $000s	2022 $000s	2023 $000s	2024 $000s	2025 $000s	2026 $000s
Murraylink Electricity Interconnector	2,642	2,106	3,056	6,692	3,157	1,409

Table 1 – Executive summary of SIB capital expenditure for CY2021 to CY2026

1 MURRAYLINK ELECTRICITY INTERCONNECTOR

1.1 Asset Information

Murraylink Electricity Interconnector (Murraylink) is a high voltage direct current (**HVDC**) electricity transmission line that connects the power transmission networks at Red Cliffs (in Victoria) and Berri (in South Australia) via HVDC cables. The facility consists of the converter stations at Red Cliffs and Berri, the DC cables connecting them and the AC cables, switchgear and converter transformers connecting each converter station to the nearby AC substation (Red Cliffs Terminal Station in Victoria and Monash Substation in South Australia). Murraylink utilises Voltage Source Converter technology. The DC cables are buried underground and are approximately 176km in length.

The Australian Energy Market Operator (**AEMO**) determines the power transmission through Murraylink as a part of their central dispatch process.
To summarise the key parameters of Murraylink:

- bi-directional maximum power flow of 220MW;
- maximum reactive power generation between +140MVAr and -150MVAr at each end;
- AC connection voltage of 220kV at Red Cliffs and 132kV at Berri; and
- DC voltage of ±150kV.

Murraylink can be divided into six categories:

- AC cable connection between Red Cliffs terminal station and the Red Cliffs converter station;
- Red Cliffs converter station;
- underground DC cables;
- Berri converter station;
- AC cable connection between Monash substation and the Berri converter station; and
- remote operator workstation and associated telecommunications.

The location of the Red Cliffs terminal station and the Monash substation, as well as the DC cable route, is shown in Figure 1.

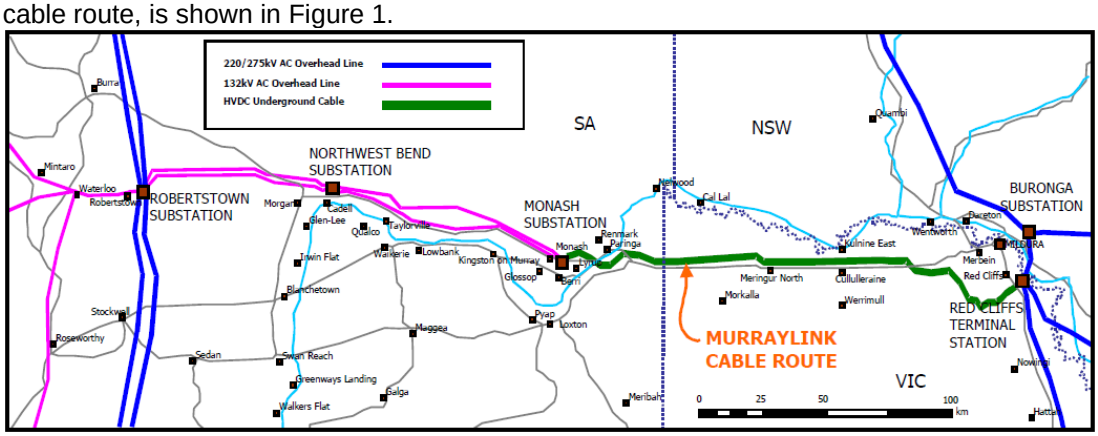

Figure 1 – Murraylink asset location and DC cable route

A simplified single line representation of Murraylink is provided in Figure 2. This diagram represents either converter station between the connection to the AC cable (either 220kv or 132kV) and the ±150kV DC cables.

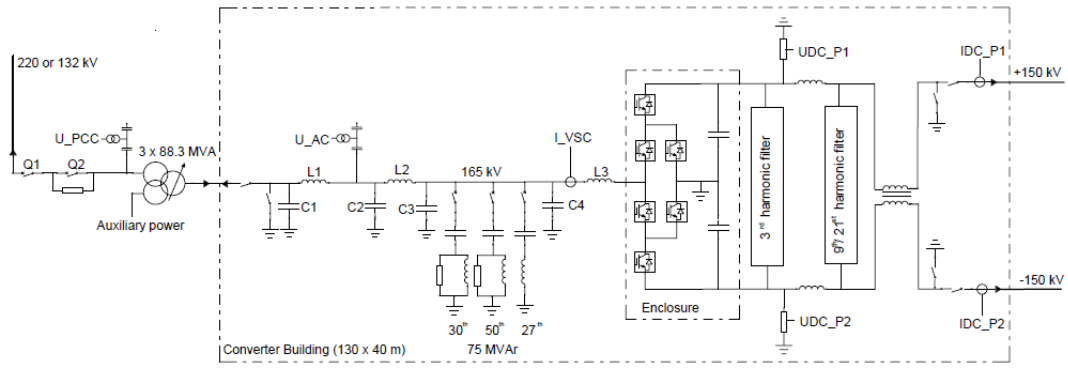

Figure 2 – Murraylink simplified single line diagram

Within each of the two converter stations, there are a number of sub-systems and major equipment categories. Based on the asset categories, 17 asset classes have been identified on which individual asset maintenance strategies are developed and maintained. These are listed below:

1. circuit breakers;
2. disconnectors and earth switches;
3. power transformers;
4. phase reactors;
5. filter reactors (including zero sequence and DC smoothing);
6. capacitors;
7. filter resistors;
8. surge arresters;
9. current and voltage transformers;
10. wall bushings;
11. IGBTs and valve enclosures;
12. high voltage cable easement;
13. control, protection and telecommunication equipment;
14. fire system equipment;
15. HVAC, valve and reactor cooling systems;
16. auxiliary power supply; and
17. buildings and structures.

Murraylink also includes a substantial spare parts holding which are stored in spare parts buildings located at both the Red Cliffs converter station and the Berri converter station. Those spare parts requiring controlled temperature/environments are stored in a dedicated air conditioned room at each of the converter station sites.

1.2 Economic Regulation

Murraylink will commence a new revenue application process in 2022, with the key dates set out in the table below.

Revenue Proposal Timetable	Due Date
Regulatory Proposal	31 Jan 2022
Draft Decision (indicative)	30 Sep 2022
Revised Regulatory Proposal (indicative)	Dec 2022
Final Decision	30 Apr 2023

Table 2 – Murraylink revenue proposal process for FY2024 to FY2028

The outcomes of the FY19 to FY23 revenue determination are set out in the tables below.

Year ($millions)	FY2019	FY2020	FY2021	FY2022	FY2023
Return on capital	6.4	6.5	7.0	7.4	7.3
Regulatory depreciation	3.4	3.6	3.6	3.7	5.8
Operating expenditure	4.5	4.6	4.8	5.1	5.1
Efficiency benefit sharing scheme (carryover amounts)	-0.2	-0.2	0.5	0	0.1
Net tax allowance	0.4	0.4	0.5	0.5	0.6
Annual building block revenue requirement (unsmoothed)	14.6	14.9	16.4	16.5	19.0
Annual expected Maximum Allowed Revenue (smoothed)	14.3	15.2	16.2	17.3	18.5
X factor (%)	-3.9%	-3.9%	-3.9%	-4.4%	-4.4%

Table 3 – Murraylink revenue determination for FY2019 to FY2023

1.3 Compliance

1.3.1 *Applicable Regulations*

1.3.1.1 Legislation

The relevant legislation that applies to Murraylink includes:

- National Electricity (South Australia) Act 1996;
- National Electricity (South Australia) Regulations;
- National Electricity (Victoria) Act 2005;
- National Electricity Rules;
- Electricity Act 1996 (South Australian Legislation);
- Electricity (General) Regulations 2012 under the Electricity Act 1996;
- South Australian Electricity Transmission Code Issue No. 9, 1 July 2018;
- South Australian Switching Manual Revision 4 November 2017;
- ESCOSA Reporting Guideline;
- Victorian Electricity Industry Act 2000;
- Victorian Electricity Safety Act 1998;
- Electricity Safety (Installations) Regulations 2009;
- Electricity Safety (Management) Regulations 2009; and
- Security of Critical Infrastructure Act 2018 Cth).
- The National Greenhouse and Energy Reporting Act 2007 (NGER Act)

1.3.1.2 Standards

1.3.1.2.1 Supply Quality Standards

Murraylink has been designed and is operated to meet the standards required by the National Electricity Rules. In addition, connection agreements exist with both ElectraNet and AusNet that specify power quality obligations.

Performance quality is monitored against supply quality standards 24 hours a day, 7 days a week at the Murraylink Control Centre in Adelaide.

1.3.1.2.2 Supply Reliability Standards

Supply reliability standards are service standards set by the AER in their final decision on the 2018 Murraylink transmission determination.

The AER determination outlines the financial bonus/penalty in terms of cap and collar as outlined in **Table 4** and **Table 5**. The bonus/penalties are set as a proportion of the AER determined maximum allowed revenue.
The market impact parameter relates to whether Murraylink causes a cost constraint on the network, due to its inability to respond to requested dispatch targets.

Parameter	Floor	Target	Cap	Weighting (of MAR)
Circuit event rate - fault	500%	200%	0%	0.75%
Circuit event rate – forced	500%	200%	0%	0.50%
Failure of protection system	4	1	0	0%
Material failure of SCADA	2	0	0	0%

Table 4 – Murraylink availability AER targets

Parameter	Target	Cap	$ per Dispatch Interval
Market impact performance	372	0	$374

Table 5 – Murraylink AER market impact targets

Internally set availability and reliability targets are outlined in **Table 6** and **Table 7**.

Parameter	Target
Target Availability (Inclusive of all planned, peak forced and off-peak forced outages)	98.03%
Target Unplanned Interruptions	<= 5 per annum
Compliance with the Safety, Reliability, Maintenance and Technical Management Plan Target Compliance Level	<1 breach per annum

Table 6 – Murraylink SRMTMP targets

Parameter	Target
Minimum Total System Availability	98.00%
Maximum Power not transferred to daily targets	5.00%
Minimum Planned maintenance to schedule	95.00%

Table 7 – Murraylink EII targets

1.3.1.3 Licences

The Murraylink Transmission Company Transmission Licence was issued as at 20 December 1999 and last varied by the Essential Services Commission of South Australia (ESCOSA) on 8 August 2019.

APA has obtained an exemption from holding a Transmission Licence in Victoria.

1.3.1.4 Reporting

Murraylink reports internally each month on its performance against the requirements set by the AER. The AER also requires annual reporting of Murraylink's actual performance against performance targets set in the AER determination. These results are publically available from the AER web site.

An EII monthly operations report is prepared at operating business unit level and compiled at national operations level and submitted to EII.

1.3.1.5 Management of Regulatory Changes

APA has a system in place to monitor and implement updates to regulatory obligations as required. Changes in legislation is monitored and managed through subscription to LAWLEX for Gas Newsfeed, Occupational Health & Safety Newsfeed and Environmental Newsfeed. Any changes to Australian and International Standards is monitored through a subscription to Standards Watch to ensure these are identified quickly and changes put into place where required.

In 2018, the Security of Critical Infrastructure Act 2018 became effective. Ownership information in relation to Murraylink was submitted to the Critical Information Centre for insertion onto its Register.

No material changes to the Acts, legislation or licence have been recorded since the last review of this AMP.

1.3.2 *Risk Management*

The effective management of risk is central to the continued safe and reliable operation of all assets. Risk management processes align with the requirements of the APA Group Risk Management Policy and Risk Management Handbook. The APA Risk Management Policy ensures that:

- appropriate systems are in place to identify all material risks that affect or could affect the integrity of Murraylink;
- the impacts of identified risks are understood and appropriate mitigation measures are in place to control exposures to those risks; and
- appropriate responsibilities are delegated to control the identified risk effectively.

APA maintains an asset risk register for this asset and manages risk controls and actions through the operations asset management framework.
In assessing the risks associated with Murraylink assets, the processes set out in the APA Risk Management Handbook will apply. Where assessing conflicting risks and mitigation measures, an imminent risk to the health, safety and the environment (**HS&E**) must always be addressed with priority. Outside of HS&E, asset management decisions shall prioritise on the basis of maintaining high availability and maximising the life of the asset.
The register is routinely reviewed and updated to ensure the continued safe and reliable operation of Murraylink and achievement of the service levels.

1.3.3 *Environmental Plan*

Murraylink manages environmental considerations through the Operations Environmental Management plan (ML-DO-05). This plan is managed by the APA Environment Group and is periodically reviewed. The general structure includes:

- a description of the main components of Murraylink including an outline of the route and location of each component. This section also has a brief description of the environmental resources found along Murraylink;
- a description of APA's environmental emergency response procedures;
- the environmental management strategies that are employed to minimise and mitigate against environmental impacts; and
- a description of monitoring, measurement and evaluation processes including incident reporting and notification.

1.3.4 *Emergency Plan*

APA has in place an Emergency Response Management Plan (320-PL-ER-0001) that applies across all of APA assets and APA managed assets, including Murraylink. This plan sets out the procedures and resources to be deployed by APA personnel in the event of an emergency or security incident at Murraylink.

The other key documents related to the management of emergencies and major failures of Murraylink are:

- 330-PL-HSE-4001 - Emergency Management Plan (Murraylink).
- ML-DO-05 - Operations Environmental Management plan.
- 330-PR-OM-0006 - Response to a Serious Electrical Accident.
- 330-PR-OM-0007- Response to a Serious Electrical Accident – External.
- 320-PL-ER-0016 - Bushfire Management Plan

1.4 Key Performance Measures

1.4.1 *Supply Performance Criteria*

The following annual performance measures and targets as set by the AER are applicable from the middle of 2018 onwards as a result of the transition to a new revenue period.

Calendar Year Performance Measure and Results	Measure	Target	YTD 2021 (Jan to Sep)
Circuit event rate - fault	%	200%	100%
Circuit event rate – forced	%	200%	200%
Failure of protection system	No.	1	0
Material failure of SCADA	No.	0	0
Outage constraints with a marginal value > $10/MWh in a Dispatch Interval	No.	372	798

Table 8 – Murraylink performance measures and data

1.4.2 *SIB Project Measurement*

1.4.2.1 CY2021 Capital Works

A reflection on the capital projects for the current year.

Year	Forecast $000s	Budget $000s	$ Variance	% Variance
2021	2,642	1,538	(1,104)	(71.8%)

Table 9 – Murraylink capital projects review

Commentary

Deferred payments for the Murraylink control system upgrade have caused an increase in 2021 capital expenditure relative to the budget from the 2020 AMP. The project overall continues to track to the overall project budget.

1.4.2.2 Major Planned Operational Expenditure (OPEX)

Year	Description	Planned/Completed Month
2021	Annual Maintenance	September

Table 10 – Murraylink major maintenance works

1.5 Lifecycle and Technical Operating

1.5.1 *Capital Works (Stay in Business)*

ID	Description	2022 $000s	2023 $000s	2024 $000s	2025 $000s	2026 $000s
1	Cable relocation	35	37	-	-	-
2	Spares	33	15	-	-	-
3	Other minor capital works - Converter Station Subsystems	190	162	-	-	-
4	Cooling water drive replacement	390	-	-	-	-
5	Battery chargers	138	-	-	-	-
6	Cable Protection	50	-	-	-	-
7	Cable Modification	-	120	240	1353	240

8	Essential Spares	50	115	229	229	229
9	Obsolete IGBTs	520	712	712	712	712
10	Testing Equipment	-	72	-	-	-
11	Reliability	-	304	1,481	-	-
12	Stay in Business	-	659	1,524	712	77
13	Refurbishment/Replacement	-	75	151	151	151
14	Enhanced cooling systems	-	785	2,355	-	-
15	Control Room SCADA	250	-	-	-	-
16	Upgrade industrial computer control system	450	-	-	-	-
	Totals	**2, 106**	**3,056**	**6,692**	**3,157**	**1,409**

Commentary

The capital expenditure shifts into the capital works categories mid 2023, marking the start of a new Murraylink revenue period (July 2023). The new Captial works categrories ID 6 onwards represent the categories to be used in the Murraylink revenue proposal to the AER.

1. Cable relocation

The Murraylink cable may require relocation to make way for potential developments, or road realignment, along the cable route in the future. The Murraylink cables have non-exclusive rights to occupy road reserves under section 93(1)(d) of the Electricity Industry Act and a licence with Vic Roads in Victoria; and under section 47 the Electricity Act in South Australia. In the event that some future development is planned for an area where the cables are installed, Murraylink is likely to be required to relocate or otherwise protect the cables from damage. This proposal is contingent on a future development that requires the relocation of the Murraylink cables and where Murraylink is unsuccessful recovering costs.

From 2024 onwards, this item is moved to Cable Modification and Protection.

2. Spares

To maintain the high level of plant integrity a contingency for critical spares has been allocated. This amount is surplus to the allowed capital expenditure within the current Access Arrangement.

From 2024 onwards, this item is moved to Essential Spares.

3. Other minor capital works

An on-going level of capital work is required to refurbish components of the converter station subsystems. The reliable operation of the converter stations is dependent on the proper operation of a number of sub-system. These subsystems perform essential operation functions such as cooling primary HV equipment, cooling computerised control system equipment, LV power distribution. The expenditure on these items is unevenly spread throughout the regulatory control period as the essential maintenance on each becomes necessary. This expenditure includes refurbishments of equipment with rotating or other moving components.

From 2024 onwards, this item is moved to Refurbishment/Replacement.

4. Cooling water drive replacement

Cooling water circulation pumping systems are essential to the operation of the Murraylink HVDC by ensuring adequate cooling of the IGBT switching valves. A component of this system in the AC Variable Speed Drives which regulate the flow of water. The EOM has advised the current drives are in obsolescence phase and will need replacement in the next period. These drives have been in service since 2002. The project has been initiated in CY2021 with installation forecasted to occur in 2022. A scope assessment and updated estimate will be formed prior to works.

5. Battery Chargers

A failure of a battery charger could result in a significant outage. The battery chargers in the converter station have reached the end of their economic life and will be replaced in this revenue period. New chargers were purchased for the Berri Convertor Station in 2018 creating spare components for the older chargers located at Red Cliffs.

6. Cable Protection

This category of capital expenditure work improves the security of the cables by improving the cable protection increasing public awareness of the cable location. The items include:

- Reviewing the cable route to ensure development along the cable route has not compromised the original cable design requirements.
- Any other necessary proactive relocation of the cable route.

From 2024 onwards, this item is moved to Cable Protection/Modification.

7. Cable Protection/Modification

The Murraylink cable may require relocation to make way for potential developments, or road realignment, along the cable route in the future (e.g. relocating the DC cables out of the Victoria-South Australia inspection station area). Further cable marker signs require update to ensure the visibility and spacing is consistent with current developments and community safety requirements.

8. Essential Spares

To maintain the high level of plant integrity, an amount for critical spares has been allocated. This category of expenditure procures spare parts essential for the ongoing operation of the converter stations. The items includes Capacitors and other spares as required by component failure. This category now includes amounts under spare capacitors in the prior AMP.

9. Obsolete IGBTs

The OEM has advised that there is a limited number of spare generation 2 IGBTs available. This category of capital expenditure allows for increased purchase of spare IGBTs to ensure sufficient Murraylink stock levels are held so as to avoid the need to upgrade for as long as reasonably practical. This category includes amounts classified as spare IGBTs in the prior AMP.

10. Test Equipment

This category of capital expenditure replaces obsolete test equipment and systems for the ongoing reliable operation of the converter stations. The items include: cable Hi-pot tester and thumper replacement; and IGBT Tester replacement.

11. Reliability

This category of capital expenditure work enhances the service provided by Murraylink to the National Electricity market. The items include:

- UPS systems enhancements;
- Flood migitation measures;
- Critical Infrastructure security enhancements (previously its own category);
- Auxiliary power supply upgrades (previously its own category).

12. Stay In Business

This category of capital expenditure ensures the continued low risk provision of transmission service by Murraylink. The itmes include:

- Operational scada upgrades;
- Protection relays upgrades;
- Necessary upgrades to converter station buildings and facilities;
- Proactive enhancements to avoid equipment failure;
- Cable fault realys (previously its own category);
- Transformer condition monitoring (previously its own category); and
- Phase Reactor Cooling and I beams (Pipework Refurbishment) (previously its own category);

13. Refurbishment/Replacement

The refurbishment works are planned to ensure the ongoing serviceability of a range of ancillary equipment at the converter stations. This equipment is essential to the continued reliable performance of the converter stations. These items include:

- Valve and reactor cooling system pumps
- Valve and reactor cooling system electric motors
- Cooling tower electric motors
- Motor control centre motor start contactors
- Motor control centre control relays
- Motor control centre switches
- Dehumidifiers

14. Enhanced Cooling Systems

This category of capital expenditure will limit the impact of high summer ambient temperatures on transmission services. It is proposed to implement secondary cooling systems to enhance the heat rejection of the existing cooling equipment. Included in this category are amounts related to deioniser upgrade, nitrogen independent supply and Upgrade cooling towers to enhanced cooling system identified as separate projects in the prior AMP.

15. Control Room SCADA

This project is to develop the SCADA infrastructure to provide control room services for Murraylink from the APA Integrated Operations Centre (IOC). The contract between ElectraNet and Murraylink, for providing control room services, is due to expire in September 2022. APA intends to provide the future control room services for Murraylink from the IOC.

16. Upgrade industrial computer control system

The work to replace the Murraylink control system is materially complete. The contractor has not been able to complete the works due to COVID related travel restriction. The outstanding work is expected to be completed in April 2022.

Appendix B outlines the delivery schedule for CY2022.

1.5.2 *Capital Works (Growth)*

There are currently no plans to grow the asset and no capital growth expenditure was approved by the regulator within the current Access Arrangement.

Appendix A – Murraylink Stay in Business Capital for CY2022

ML SIB Capital $'000	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	CY22 Total
Cable relocation	-	-	-	-	-	-	7	7	7	7	7	-	**35**
Spares	3	3	3	3	3	3	3	3	3	3	3	-	**33**
Other Minor Capital works - Converter Substation Subsystem	-	-	-	30	40	40	40	40	-	-	-	-	**190**
Cooling water drive replacement	150	100	100	40	-	-	-	-	-	-	-	-	**390**
Battery chargers	-	14	-	-	-	-	55	69	-	-	-	-	**138**
Cable Protection	-	-	-	-	-	50	-	-	-	-	-	-	**50**
Essential Spares	-	10	-	-	-	-	-	40	-	-	-	-	**50**
Obsolete IGBTs	-	-	-	-	-	-	-	-	-	-	520	-	**520**
Control Room SCADA	-	40	50	80	80	-	-	-	-	-	-	-	**250**
Upgrade industrial computer control system	-	-	-	450	-	-	-	-	-	-	-	-	**450**
Murraylink Sub Total	**153**	**167**	**153**	**603**	**123**	**93**	**105**	**159**	**10**	**10**	**530**	**-**	**2,106**