Progressive closure planning at the Magellan mine; providing some certainty in uncertain times

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Abstract

Closure planning in the mining industry has been typically left until near the end-of-mine life, often leaving little time, financial provision or resources for effective closure planning and implementation. Ideally proponents would commit resources and time for closure planning from the commencement of operations to optimise financial return through effective planning and enhanced efficiency.

Limitations associated with closing a mine in an unplanned manner include inadequate financial provision, substandard and expensive rehabilitation, and limited access to adequate equipment and materials. The lack of time to trial rehabilitation methods, the absence of corporate memory due to personnel departures, coupled with an extended post closure monitoring and maintenance period, will all contribute to prolonged tenement relinquishment and continuing liability for proponents.

Magellan Metals Pty Ltd owns and operates an open-cut lead carbonate mine and processing facility, located approximately 30 km from Wiluna in the Mid-West region of Western Australia. Magellan required a dynamic system to facilitate early and effective rehabilitation and closure planning over the life of the mine. The concept of 'progressive rehabilitation' has been expressed in publications in Australia since 2000 (ANZMEC/MCA, 2000) and was expanded upon in 2002 within the Mine Decommissioning Best Practice Manual (Environment Australia, 2002).

Specifically, Magellan required a closure system that would facilitate the establishment of closure planning tasks, allowed for tracking of these tasks and for performance monitoring over time.

Magellan contracted a consultancy to implement their product, a progressive rehabilitation and closure (PRAC®) system, to achieve these objectives. The PRAC® system is a spatially managed closure planning system that allows proponents to track and measure closure progress via a web-based platform. Dedicated closure tasks are established within the system and the proponent is able to allocate resources against those tasks, through standard GIS information and aerial photography. The system also integrates active links to relevant supporting documentation.

The PRAC® system has allowed Magellan to better estimate its closure liability in an uncertain and challenging financial, political and environmental climate. Its implementation has also allowed Magellan to demonstrate closure planning progress to internal and external stakeholders.

1 Introduction

Planned mine closures are rare; in-voluntary mine closures are more common and are related not only to the depletion of mineral reserves, but also to economic instability, regulatory intervention, geological and technical issues, policy changes, social and community pressures, and environmental incidents (DITR, 2006). With confidence in capital markets currently low, the potential for unplanned mine closures has increased, and is likely to further increase as the follow-on effects of the global economic crisis impact the mining industry. The value of effective closure planning and implementation has increased, and while commodity pressure and high-capital commitments may preclude the continual operation of a mine, these economic constraints may also mean there is insufficient financial provision to undertake required closure and rehabilitation activities.

Magellan Metals Pty Ltd (Magellan) operates an open-cut lead carbonate mine and processing facilities approximately 30 km west of Wiluna in Western Australia. The Magellan Project, commissioned in October 2005, produces lead carbonate concentrate for export in the production of lead-acid batteries for vehicles, critical infrastructure systems and as storage for renewable energy systems.

In these uncertain times, Magellan required a closure system which would provide clarity in designating closure planning tasks, allowed for tracking of these tasks, and for performance monitoring over time. Magellan engaged Outback Ecology to implement their progressive rehabilitation and closure (PRAC®) system, to achieve these objectives. The PRAC® system is a web-based application with a Geographic Information System (GIS) interface that facilitates a shift from hardcopy closure plans to dynamic electronic closure systems. The system enables the management of tasks and documents in a spatial context, using standard GIS information and aerial imagery.

2 Mining in uncertain times

Ideally mines only close when their mineral resources have been extracted and a suitable mine closure plan has been developed and progressively implemented. Unfortunately planned closures are rare. In the past two decades almost 25 per cent of mine closures in Australia have been unplanned (Laurence, 2002).

The global economic crisis that began during 2008 has eroded confidence in capital markets and has lead to sharply deteriorating global economic conditions, causing recession in many developed countries. In the mining industry the number of unplanned mine closures has increased; some mines have moved on to care and maintenance which can be a precursor to full closure. For the period from 2008 to the end of the first quarter 2009 there were over 100 premature mine closures internationally (**Figure 1**) (Laurence, 2009).

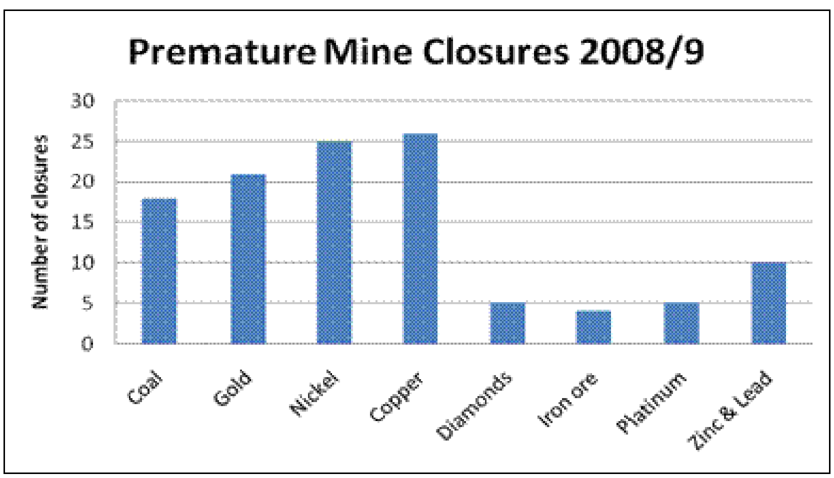

Figure 1 Premature mine closures by commodity from 2008 to the end of first quarter 2009

Given closure planning has been typically left until near the end-of-mine life and given the recent acceleration in the number of mine closures, there is even less time for effective closure planning and implementation. As closure inherently involves a large-scale reduction of existing staff and contractors, the corporate memory required for effective planning and implementation may also be lost.

There is an increasing expectation on mining companies to ensure there is adequate financial provision to reflect the real cost of closure and rehabilitation, since mine closure takes place when there is typically no return from the operation and there may be little economic value in the remaining assets (ANZMEC/MCA, 2000). This expectation will only increase in light of the global economic crisis. Boards are increasingly required to report on liabilities and closure costs, and as matter of general due diligence. The International Financial Reporting Standards (IFRS) now have greater focus on mine closure liabilities, including environmental and restoration liabilities (PWC, 2007). In accordance with the IFRS, a progressive approach to mine closure effectively allows costs to be progressively allocated, budgeted, and reported during the life-of-mine. As closure tasks are completed, their individual cost can be reconciled, and progress against liability reduction can be demonstrated within an organization.

3 Context for Magellan

Routine closure plans are inherently static and do not make provision for the establishment or tracking of ‘tasks’ to progress closure planning. Routine closure plans do not allow for progressive updates as additional technical, regulatory, environmental and/or social information becomes available. Furthermore, effective mine closure planning and implementation requires ongoing allocation of resources, delineation of responsibilities and project management, all components that are not embedded within a routine closure plan.

Magellan required more than a routine mine closure plan; they required a dynamic approach to closure planning in order to facilitate progressive rehabilitation and closure planning over the mine-life. Magellan wanted an approach that would facilitate the establishment of closure tasks, and that allowed for tracking of these tasks and for monitoring of performance over time. The desired approach also had to include a document management system to integrate the large volume of reports, photographs and data that is generated over time and is critical for closure planning.

4 Progressive rehabilitation and closure

Magellan contracted Outback Ecology to implement their PRAC® system. The system is a spatially managed closure planning system that allows proponents to track and measure closure progress via a web-based platform. Dedicated closure tasks are established within the system and the proponent is able to allocate resources against those tasks, through standard GIS information and aerial photography, and integrated documentation. The PRAC® system was developed in accordance with the principles of the ‘Strategic Framework for Mine Closure’ (ANZMEC/MCA, 2000).

The basis of the PRAC® system is that the current knowledge base for any defined area forms the platform from which a rehabilitation and closure strategy for that area can be established (Mackenzie *et al*., 2008). Through the process of gap-analysis, tasks can be identified to fill-gaps and ultimately refine the rehabilitation and closure strategy for specific areas. This enables early identification of high risk priorities and allows progressive reduction of environmental liabilities.

Magellan wanted to implement a progressive rehabilitation and closure system so that planning and closure became a life-of-mine process. Progressive rehabilitation and closure planning represented a method in which Magellan was able to identify areas of high-risk early and reduce their environmental liabilities by progressive closure planning and rehabilitation. Therefore, in the event of an unplanned mine closure, a closure plan would be in place, rehabilitation would be underway, closure liabilities understood, and the likelihood of expedient tenement relinquishment would be more likely. The early relinquishment of tenements will assist with cash flow as environmental bonds are released.

Progressive closure and rehabilitation planning has facilitated Magellan’s drive for performance monitoring of their landforms during operations, instead of at the end of mine-life. This will result in performance data being available for analysing the effectiveness of Magellan’s rehabilitation program, thus enabling well informed decisions to be made with regard to future rehabilitation designs and procedures. This monitoring data will be used to demonstrate performance against closure criteria, which will form the basis for future bond reduction applications.

By having a progressive rehabilitation and closure system in place Magellan is providing its stakeholders with a level of confidence that the mine is being well managed, ultimately enhancing Magellan's reputation with its stakeholders.

5 PRAC® system

The PRAC® system is a GIS-based application that facilitates a shift from hardcopy static closure plans to electronic closure systems. The system is internet-based, meaning it can be accessed securely from a computer anywhere which has internet access. The strength of the PRAC® system is that tasks and documents can be managed in a spatial context, using standard GIS information and aerial imagery.

Internet-based GIS software is fast becoming the standard medium for managing location based data. There are a number of reasons why this is happening:

- Free GIS software such as Google Earth has made GIS technologies accessible to anyone who has an internet connection.
- Aerial imagery is becoming less expensive to capture and image quality is improving.
- Internet speeds are increasing making it easier to run internet based applications.
- Data storage is becoming simpler and less expensive, making it easier to store large volumes of data required to run GIS software.

6 Case Study

6.1 Magellan environmental setting

Portions of the Magellan tenements lie within operational pastoral leases. The climate of the region is semi-arid, affected by high intensity summer storms either of conventional derivation or as degrading tropical cyclones, generally accompanied by widespread heavy rainfall. The mine area is characterised by low hills and gently undulating plateaus flowing down to calcrete drainage plains. The mine is situated on a sloping plateau surrounded by calcareous drainage lines and saline soils (Lindbeck, 1999). A quartz-clay breccia found in the Yandal Formation hosts the Magellan lead mineralisation. This breccia has a high porosity, and can be weakly ferruginous and weakly calcareous (Cooper, 1999). Vegetation in the region is sparsely dispersed and dominated by Mulga scrublands, with the occasional taller shrubs or trees species. Vegetation reflects a long history of stock grazing, and is generally classed as of poor to moderate health. Fauna identified around Magellan reflects the poor health of vegetation at the site, with small numbers of individuals caught or observed during surveys. Generally, the species present at Magellan are limited due to the impact of grazing (Lindbeck, 1999).

6.2 Magellan Operations

The Magellan lead-carbonate mine employs shallow open pit mining techniques and has an estimated mine life of approximately 10 years (Lindbeck, 1999). Lead-carbonate ore is feed through a conventional crushing and grinding circuit. A flotation circuit produces concentrated lead carbonate which is packaged in sealed bulk bags and transported in locked shipping containers by road and rail for export. The Magellan mine comprises the following key features (**Figure 2**):

- Two open cut pits with a current estimated depth of 40 m (Magellan and Cano).
- Tailings storage facility (2 cells) encompassing an area of 66 ha.
- Waste rock dump with a final estimated footprint 138 ha.
- Run of mine pad adjacent to the processing plant.

- Process and raw water ponds, for raw water and tailings decant storage for use in processing.
- Lead processing facilities, including a crushing circuit, semi-autogenous grinding mill, and a sulphidisation flotation circuit.
- Concentrate storage facilities.
- Duel fuel power station and associated infrastructure.
- Reverse osmosis plant for production of potable water.
- A number of workshops.
- Sewage facilities, located adjacent the accommodation village and mine offices.
- Landfills, one located within the immediate mining area for disposal of rubbish from this area and the second located outside of the immediate mining area for disposal of domestic materials.
- Mine offices and accommodation facilities for up to 200 personnel.
- Haul and access roads
- Drill sites and other exploration associated disturbances.

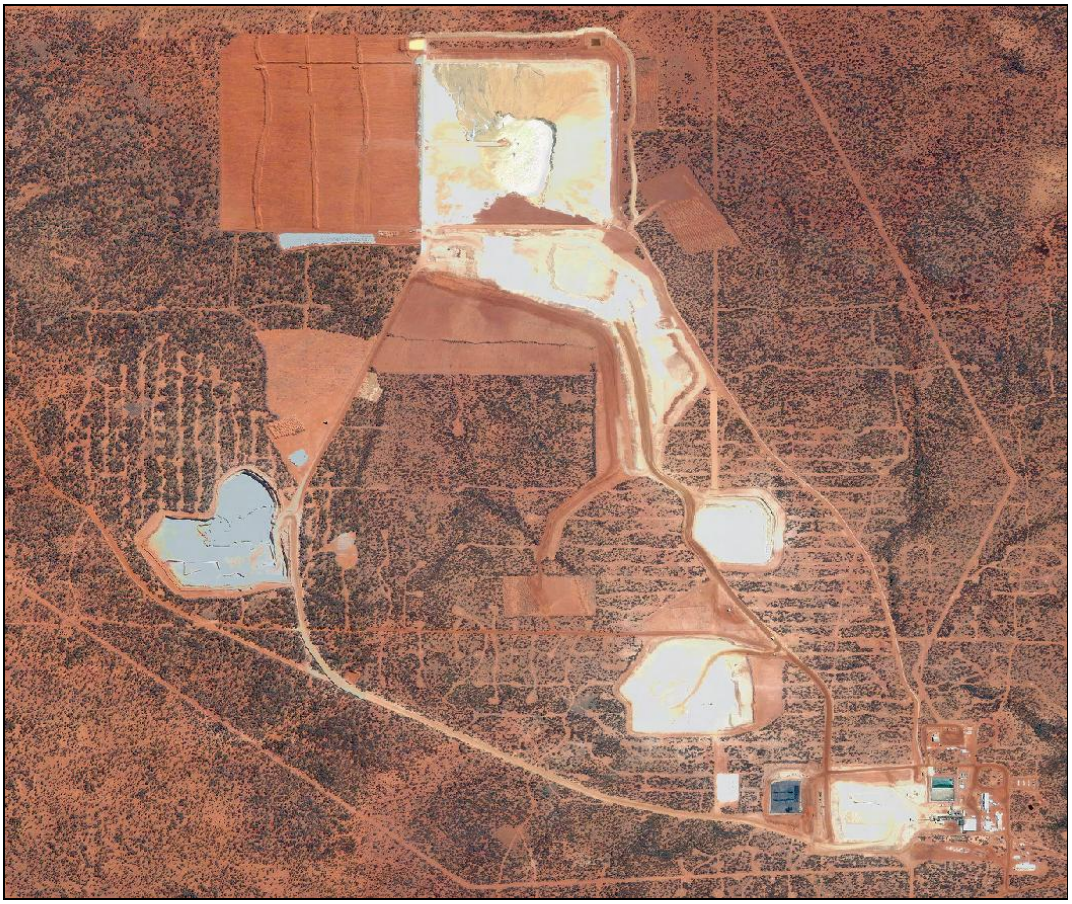

Figure 2 Magellan lead project

6.3 Magellan – PRAC® system development

Firstly the mine area was divided into physically distinct 'features' then all available and relevant information was reviewed for each feature and summarised into a 'knowledge base' document. Through the creation of the 'knowledge base' document, corresponding 'knowledge gaps' were identified that may limit the development of effective closure and rehabilitation plans for each feature. Investigative and rehabilitation tasks were created to close each knowledge gap, and prioritised over the life-of-mine to create a 'progressive rehabilitation and closure strategy' for each feature.

The PRAC® system manages the various tasks (investigative, monitoring or rehabilitation tasks) for each feature on a mine. Once established, tasks can be scheduled logically over time. Tasks can be managed via the GIS-interface or through an interactive Gantt chart. Tasks are marked as 'not-complete', 'in-progress' or 'completed', allowing effective tracking of achievements over time and re-establishment of planning priorities (**Figure 3**).

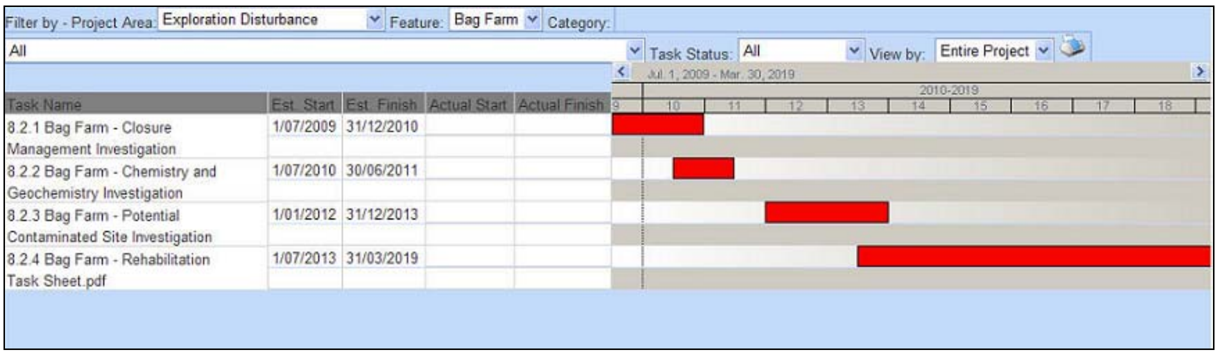

Figure 3 Gantt chart of investigative and rehabilitation tasks for the bag farm

When viewed through the Gantt chart, tasks can be sorted by the project area they relate to, their status and/or their category. There are six different categories of tasks, enabling quick reference to similar tasks to optimise the allocation of specialist resources. Task queries can be generated for reporting requirements. In addition, tasks can be emailed or printed by a project manager for the personnel responsible for their completion.

Additionally the PRAC® system hosts electronic copies of all relevant and referenced documentation including monitoring data, historic approvals documents, knowledge base and gap documentation, and related reports. Copies of the documents are held in a secure register. Links to specific documents are established for each project area and are accessible through a global search function (**Figure 4**). This function allows the user to search and access all documents hosted within the system.

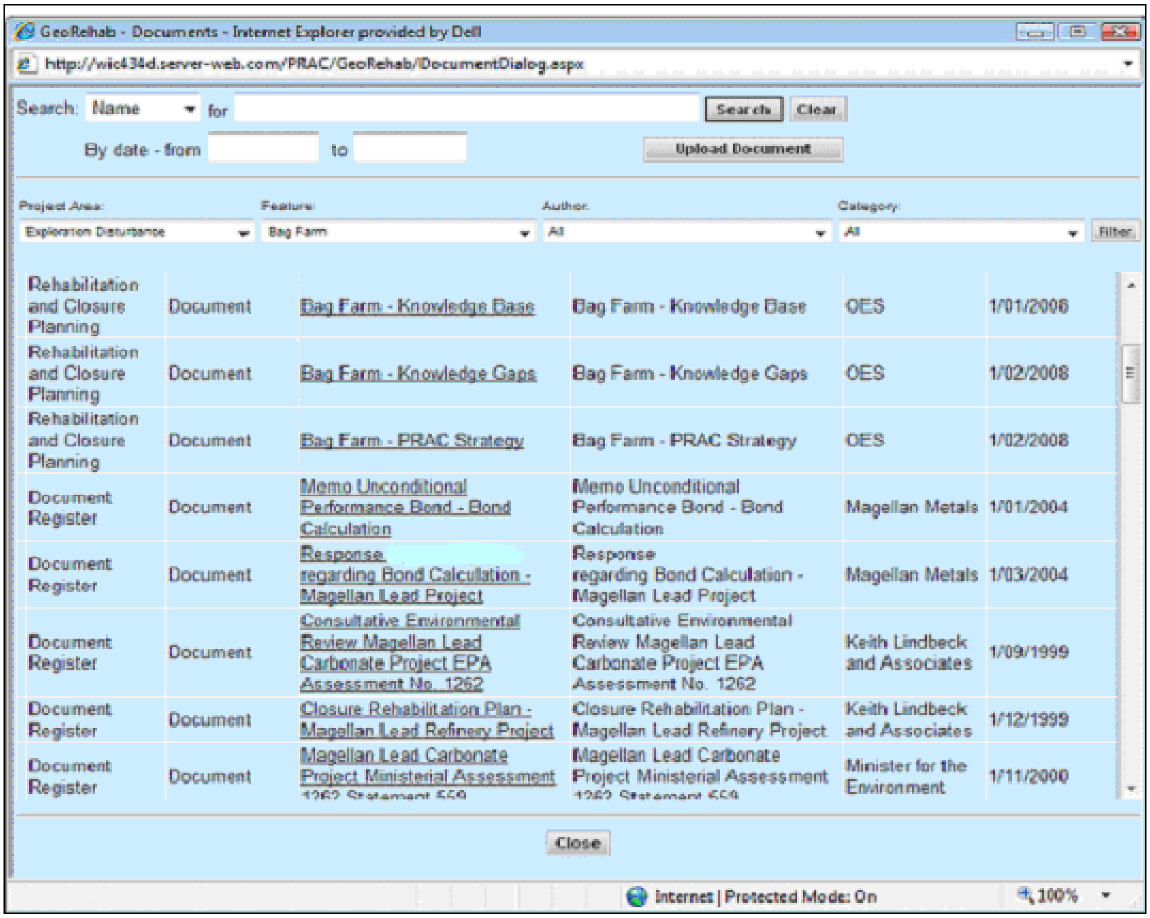

Figure 4 Document search function in Magellan PRAC® system

6.4 Example – the 'Bag Farm'

An example of the planning process is given here for the 'bag farm'. The exploration bag farm is located on one of Magellan's mining tenements. The area is used to store sample bags from exploration undertaken prior to and during mine operations. No topsoil appeared to have been removed from the area prior to storage of the exploration bags.

Given this information three knowledge gaps were identified in relation to:

1. Soil chemistry of the bag farm (chemistry and geochemistry investigation).
2. Potential implications for contaminated sites legislation (potential contaminated sites investigation)
3. Understanding the long-term land-use requirements (closure management investigation).

Based on the current level of understanding as detailed in the knowledge base the rehabilitation task for the bag farm would involve:

- Removal and appropriate disposal of all sample bags and drill spoil.
- Removal of any impacted soils for disposal.
- Re-spreading stockpiled topsoil and/or vegetation mulch where available.
- Lightly ripping compacted areas.
- Seeding with local provenance seed where required.

Closing the knowledge gaps by completion of the investigative tasks outlined above will enable this rehabilitation plan to be finalised or adapted as required.

Exploration bags are designed to break down over time; therefore the potential for spills from exploration bags is considered high. Knowledge of soil chemistry at the bag farm (detailed as a knowledge gap) is required to establish to what degree spills from the exploration bags must be removed. Maintaining existing topsoil and limiting the volumes of soil requiring removal would reduce closure costs.

Validation sampling results from soil within the bag farm should be compared against agreed closure standards, particularly for lead, to ensure compliance.

One of the advantages of progressive rehabilitation and closure planning is that areas no longer required can be closed out. Often this may be possible prior to the actual closure of the mine, which allows costs associated with closure to be split over a number of years and also allows for progressive reduction in liabilities.

The progressive closure and rehabilitation strategy for the bag farm assessed the priority for these tasks and ordered them accordingly (**Figure 3**). For all features, outcomes of the investigative tasks are incorporated back into the PRAC® system, including adaptation of the rehabilitation strategy as required.

8 Conclusion

Current uncertainty within economic markets has seen unplanned closures of numerous mining operations within Australia and overseas. It is likely this trend will continue until confidence returns to markets and commodity prices rebound. It is during these uncertain times that organisations may not be adequately prepared for effective closure and rehabilitation of their operations. Consequences of being unprepared for closure include high risk issues going unidentified, ongoing financial liabilities, delaying or forfeiting of tenement bonds, and loss of reputation with regulators and other key stakeholders. Progressive rehabilitation and closure planning is therefore most critical during these times as it reduces the risk of operations suffering these consequences.

Magellan has recognised that progressive mine closure planning will result in a number of benefits to its operation. Benefits will be seen from a financial perspective through better planning leading to enhanced efficiency and improved cash flow. From an environmental perspective, progressive planning has facilitated ongoing feedback of environmental performance through monitoring, resulting in enhanced rehabilitation outcomes. Magellan believes the financial and time commitments it has made in preparing and implementing a progressive mine closure strategy will result in improved ability in estimating closure liabilities and improved ability to demonstrate closure planning and rehabilitation performance to key stakeholders.

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