Silver Linings: Purpose Built Repositories—The last 25 years

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Over the past twenty-five years purpose built archival repositories have changed substantially, both in their design and in the way they are perceived to perform their intended functions. From once being considered merely as monolithic, nuclear bombproof structures in which to house limitless quantities of records, a much greater appreciation of these facilities has evolved. There is now a greater understanding of their total integrity and of the way in which many components combine to provide conditions necessary for the preservation of permanent value records. This article focuses on how purpose built archival repositories in Australia have changed and the impact that modern technology has made on these facilities. Whilst emphasis is given to the experiences of the Australian Archives, reference is also made to other organisations.

IN THE LATE 1960s AUSTRALIAN ARCHIVES (then known as the Commonwealth Archives Office) began planning for the construction of a purpose built records storage repository in the Sydney suburb of Villawood. At this time the building was unique to the organisation in that it would be its first truly purpose built facility and, for that matter, one of the earliest in Australia. Concurrently, the Archives Authority of NSW was building a similar facility at Kingswood, fifty-five kilometres west of Sydney. Australian Archives

had already commissioned repositories at both Collinswood, South Australia and Cannon Hill, Queensland, but these were adaptations of other designs and were not purpose built facilities in the true sense of the term.

The Villawood project was referred to the Commonwealth Parliamentary Standing Committee on Public Works for consideration. The Committee investigated and reported favourably back to Parliament in June 1970. The project was subsequently endorsed and work began shortly thereafter, the two stage facility being completed in August 1975.

Since the construction of Villawood, Australian Archives has commissioned a series of purpose built repositories in all capital cities. These include Nightcliff, Northern Territory; East Victoria Park, Western Australia; Mitchell, Australian Capital Territory and Rosny Park, Tasmania. In addition, both the Collinswood and Cannon Hill facilities have undergone purpose built extensions. The program commenced in 1970 has now culminated with the Archives' latest purpose built facility—East Burwood in Victoria—which was opened in February 1994 at a cost of $9.6 million.

Over the past twenty-five years the Australian Archives has gained a much greater understanding of how to design and build purpose built repositories and, more importantly, how these facilities perform the functions expected of them. Much has been learned—from past experiences, from the impact of changing technology and from international research into factors involved in archival storage. The changes which have occurred since the design of Villawood have in some cases been quite dramatic.

A quarter of a century is an ideal time to reflect on the past and to consider the way in which technology has affected the purpose built repository of today. A good example of just how rapidly technology is changing is provided by Michel Duchein's *Archive Buildings and Equipment*. The second English edition was published in 1988, only six years ago. Duchein discusses halon as a means of fire protection[1] yet this gas has now been shown to damage the ozone layer and its use, particularly in Australia, is rapidly diminishing. Duchein describes fumigation chambers which use ethylene oxide,[2] however, this gas is now known to be carcinogenic and it is not used by Australian Archives or most other archival authorities. Lastly, Duchein makes no reference to building management systems, yet, as will be shown later, they have made a substantial impact on the daily operation of repositories and are present in many facilities, as well as museums and libraries.

This paper gives particular emphasis to the experiences of Australian Archives but will not be limited to that organisation. Other institutions, such

as the Archives Authority of NSW and the Queensland State Archives, have also built or expanded their repositories in recent years. Further, BHP Pty Ltd is currently building a new facility at Portside, Melbourne. Nor is construction confined to Australia. Numerous facilities have been built in other countries. Some of these are described by Kitching[3] and in a special issue of *Archivum*.[4] The largest repository in the world—Archives II located in College Park, Maryland, USA—was only recently completed. Such is the immensity of this facility that its cost has been met by means of a Government bond issue. Lastly, an extension to the Public Record Office at Kew in the United Kingdom is presently under way.

Purpose built repositories

The last twenty-five years have seen the publication of a number of studies on purpose built repositories as well as the emergence of standards applicable to these buildings. One of the most notable is British Standard 5454, first published in 1977 and revised in 1989.

Before considering the role of the purpose built repository, it is appropriate to consider precisely what is meant by the term. BS 5454 defines a repository as 'a place of storage for documents, so constructed and maintained as to prevent damage, decay and unauthorised access, and to furnish, for archival documents, proper conditions of custody'.[5]

Duchein's 1988 study uses the term 'archives building' and his definition is much more elaborate, requiring the repository to meet four fundamental requirements, i.e.

(a) the preservation of documents in complete safety, which requires sound premises, protected against fire, humidity, excessive sunlight, insects, rodents, thieves, etc.;

(b) the production of documents to users, which requires space for listing, packing and labelling; as well as catalogues and inventories, reading rooms, reception and public information areas;

(c) repair of damaged documents; and

(d) reproduction of documents: microfilm, photocopies, etc.'[6]

Australian Archives uses the term 'purpose built repository', the crucial part being *purpose built*. A repository is not simply a building in which to store records, as any building can perform this function. Even a tin shed will provide some protection. In essence, a purpose built repository is designed and intended to perform two principal functions. Firstly, it must protect records

stored within it from atmospheric pollution, fire, flooding, pest infestation and vandalism, thus helping ensure their continued availability to future generations. Secondly, it must provide a safe and comfortable environment for staff and visitors. Given today's severe financial conditions, a third criterion might also include storage longevity, i.e. ensuring that the initial facility can accommodate the maximum quantity of records for as long a period as possible before an expansion is contemplated.

How the purpose built repository meets these criteria and how it is actually perceived has changed substantially since the end of World War II. In 1944 Louis A. Simon, an American architect, considered repositories solely in terms of their capacity to accommodate future record intakes. In other words it seemed that they were buildings of almost limitless capacity, a view that was still popular when Michael Saclier was writing on storage repositories in the early 1970s.[7] In the 1960s a prime factor in the design and location of the purpose built repository was its resistance to nuclear explosions (no doubt a by-product of the Cold War). Certainly consideration was given to the building's air-conditioning system, security and fire protection and other matters, but in reality such buildings were often perceived as 'concrete filing cabinets'.[8]

Both the Villawood and Kingswood repositories are large, almost monolithic structures and resistance to nuclear explosion was part of the thinking in their design. Villawood's size is of special note. It has never been extended yet its original storage capacity of over 194 kilometres makes it substantially larger than any other facility built by Australian Archives. Present indications are that it will last well into the next century without any expansion.

Since the 1970s, however, a number of changes have occurred. Firstly, repositories are generally becoming smaller, College Park being the notable exception to this rule. This change has not arisen solely in response to stringent economic conditions. It dovetails with the second change in that facilities are no longer viewed as simply providing limitless records storage. There is now a much greater understanding of the building's total integrity. We now think in terms of a building's capability of sustaining environmental conditions, not just creating them. We think of the entire building structure — e.g. walls, roofs—as a means of aiding this process. Repositories are now designed as a 'total preservation environment for the storage of archives'.[9] For this reason repositories with smaller compartmentalised spaces are much more likely to meet this requirement than larger, open plan buildings. Lastly, there has been a trend away from multiple sites in favour of single locations with combined storage functions and a client (usually the general public) interface.

Ironically, whilst the way in which the archival profession perceives repositories has changed, the media's attitude to repositories and to archivists has not. The media still delight in portraying the image of repositories as dirty buildings with dusty files, covered in spiders and cobwebs. There appears to be a long, educative process still ahead.

Design and designing

When planning the design of a new facility it is a relatively easy task for archivists to outline their requirements as part of a user brief.[10] Not all archivists, however, have had experience in this field and they may turn to other sources for support.

A typical purpose built repository is usually divided into five principal areas:

- staffing — including offices, conference/training facilities, amenities;
- clients — public and official search rooms, libraries;
- records storage — usually the largest area;
- special services, e.g. preservation, reprography, book conservation; and
- services — air-conditioning plant and auxiliary equipment.

Archivists know that their new building must meet a number of standard requirements. They know that staff and visitors should be housed in comfortable surroundings. They now know that the records storage areas should form an integrated environment to ensure stable environmental conditions. They know that the roof must never leak. They know (or at least they should) that the building's principal air intakes should not be near the carpark or facing a main road. In essence, they know that long after the building itself ceases to function (and hopefully has been replaced by another) the records it houses will have survived in a satisfactory condition.

The real difficulty lies in conveying these requirements to architects, engineers and builders and in ensuring that the five aforementioned areas interrelate. In this context what is over-looked is not the design of the facility but the designing, i.e. the final design should be such as to ensure the ability of the building to function in an integrated form. All too often this is undervalued.

Work flows must be fully recognised and understood. They should show how the public areas interrelate with storage, there should be ready maintenance access to the air-conditioning plant and such access should allow the removal of obsolete plant items at some future stage. The plant room itself should be designed to allow for expansion at some future stage if the building itself is likely to be expanded. It should not be located adjacent to storage areas as there is always the risk of flooding. Even what might appear to be minor items can limit the ability of the building to meet its function, e.g. there should be no 'dog-leg' corners to inhibit the movement of records, entrances to storage areas should be wide enough to permit the passage of trolleys fully laden with containers and there should be adequate space for working access to records in the storage areas. Lastly, loading docks should not open directly onto storage areas.

Based on many years of experience, it can be stated with some certainty that the final factor in the design phase is the careful study of all documentation and repeated consultation with the designers, builders and planning authorities to ensure that everything has been clearly understood and put into effect. If these and many other similar factors are given due consideration at the design phase the final product will have fewer problems than is often the case at present.

Storage capacity

Australian Archives works on the principle that a building's storage capacity should be of such a size as to comfortably accommodate all existing holdings and it should be capable of accepting new transfers of records for at least another ten years. In the designing phase it is crucial to be aware of any backlogs in agencies which may be released for transfer once the new facility has been commissioned. This is especially so if the previous facility had been unable to accept transfers for some time.

In determining storage capacities a 'rule of thumb' is that one square metre of floor space will hold twelve metres in mobile shelving, if the shelving conforms to the following dimensions: 2 475 mm high (excluding the bases), 900 mm wide, 400 mm deep, with eight shelves per bay. It is stressed that this figure is very much an average and does not make allowances for pillars or other obstructions. If static shelving is to be used the ratio reduces to seven metres of shelving for each square metre of floor space. Storage areas must also be flexible, recognising that they must be able to accommodate changing record formats, both now and in the future.

Utilising existing buildings or constructing a new facility

Modern literature, particularly European, has given some thought to the issue of converting existing buildings to repositories. Reference is made to the possible use of castles, chateaux and monasteries given their age and their ability to ensure stable conditions.[11] This does not really present as a suitable option in Australia given the paucity of such buildings. Even former warehouses or similar facilities are often unlikely to present themselves as suitable candidates. It is not an easy task to find a building which has—or could have even after a costly refurbishment—a sound structure, with appropriate floor loadings, suitable air-conditioning and one which is located in a good site.

When selecting a site for Villawood in 1970 no existing suitable buildings could be found. The same occurred again for East Burwood. BHP Pty Ltd, which is presently constructing a new facility in Melbourne, could not find an existing building which would meet its parameters, even after refurbishment. In most cases, archival authorities in Australia have opted to construct a new facility rather than converting an existing one.

Selecting the site

Ideally, a purpose built repository should be located in an area which is well clear of rivers, creeks, dams and the ocean. The danger from rivers and creeks is twofold—they may flood or water may flow underground and seep through a building's foundations. Proximity to the ocean may result in salt damage to a building's fabric.

The building should be clear of any industry producing air pollution which may be damaging to records; clear of airports and flight paths; close to major record clients or be in close proximity to transport systems enabling minimum delays in providing access to records required by clients. In addition, the building should be set well back from major highways and roads to reduce the risk of vehicular pollution. Residential and light industry or technology parks present suitable options. Conversely, heavy industry sites do not.

The realities of site location, however, are often quite different. Whilst East Burwood is in a residential area near a technology park, the Villawood site is located near a chemical plant and adjacent to a paint factory. Australian Archives' Darwin and Hobart repositories are both located next to service stations and their attendant fuel tanks. Before construction of the Mitchell facility began in the late 1970s the site had to be raised so as to limit the effects of any possible flooding. BHP Pty Ltd chose to locate its new repository in

Portside, though there is the risk of vehicular pollution and the site is near the Yarra River. In this case the company preferred to be close its head office in Melbourne. The Public Record Office's principal facility at Kew is below the flight path to Heathrow airport and near the Thames River. The Archives Authority of NSW's repository is at Kingswood, over fifty-five kilometres west of Sydney and the Queensland State Archives is located at Runcorn, nineteen kilometres south of Brisbane.

In each case these were sites which were offered and accepted by the appropriate institution, even though they were well removed from the Central Business District. Government archival authorities often have to accept whatever site may be offered. At times sacrifices and compromises may have to be made with an authority accepting a site which may not be entirely suitable to its needs.

Building fabric

As stated earlier there is now an emerging trend to consider the purpose built repository as a total preservation environment. For this reason much greater emphasis is given to the building's overall fabric than was previously the case.

The repository's walls should be designed to minimise the potential for external environmental conditions influencing the conditions being maintained in the storage areas. This should also limit any migration of internal conditions.[12] Bricks have been used in the construction of storage walls in a number of Australian Archives' facilities. The organisation has now experienced problems with moisture penetration through these walls and has had to have vapour proofing material applied. All walls which surround the storage areas should be fire rated. The degree of fire rating has not, however, been standardised. The Australian Archives recommends a period of two hours. The 1977 version of British Standard 5454 recommended four hour fire rated partitioning, but in the revised 1989 edition this was deleted and no time period was specified.

Experience over the past twenty-five years has shown that the roof should be well sealed to keep out rain and wind and to prohibit the entry of birds or other pests. The roof pitch should be such as to ensure rapid water run-off and gutters should be designed to ensure water collected does not overflow during a 100 year worst case storm. Roof penetrations should be kept to an absolute minimum. There should be no internal drain pipes. In essence, watertight integrity of the storage areas is paramount.

The Villawood repository has a flat roof and over the years there have been frequent problems with water penetration. In the longer term the roof will probably require replacement. The Kingswood repository experienced similar problems with a flat roof and a new roof has since been installed. The Mitchell facility has internal drain pipes and there is the inherent risk of leakage, not to mention noise disturbance to staff during periods of heavy rainfall. Australian Archives also has a leased facility at Dandenong (Victoria) which was flooded on a number of occasions during storm activity. The problem has only recently been rectified with the construction of an additional drainage system.

The matter of windows and skylights in storage areas is a vexed question. They are discussed by Duchein,[13] BS 5454[14] and Kitching.[15] The Villawood, Mitchell, East Victoria Park and Rosny Park facilities all have windows in the storage areas, although East Burwood does not. It is Australian Archives' view that storage areas are for records not people and the organisation will now not install windows in storage areas. Likewise the Queensland State Archives has no windows or skylights in the storage areas of its Runcorn facility.

Floors and ceilings should be designed to minimise the potential for external conditions influencing conditions being maintained in storage areas. This should also limit the migration of the internal conditioned environment. Careful consideration must be given to ceiling heights in the storage areas. BS 5454 states that 2 600 mm[16] is sufficient but this is clearly inadequate. If shelving which conforms to Australian Archives' dimensions is used, then the height will be 2 475 mm; to this must be added another 150 mm for the mobile bases. Given that there is a requirement for 500 mm clearance between the top of the shelving units and fire sprinkler heads,[17] ceiling heights in such cases would need to be at least 3 125 mm. It is Australian Archives practice that storage areas should have a floor loading of at least 12 kpa if mobile shelving 2 475 mm (eight shelves) high is used. Office areas normally only require a loading of 5kpa.

Shelving tracks

If the building is new then mobile shelving tracks are best installed flush with the floor. They may be laid on the floor slab with concrete screed being applied and levelled to a height of 3 mm below the top of the tracks. This allows for the application of vinyl floor coverings which should then finish flush with the tracks. Another option is to rebate the floor slab when it is poured and then install the tracks in these rebates. Track deflection should

not exceed ±1 mm per 750 mm length when the shelving is loaded. It should be noted that floor levels are critical. Floor levels around building pillars can sometimes be uneven, being caused by 'backwash' when the screed was poured, and this in turn may lead to the grounding of mobile shelving units. This has been a common problem at Villawood.

Although the emphasis of this paper is on purpose built facilities, which are normally owned by the relevant archival authority, if the building is to be leased then shelving tracks will usually be placed above ground. In such cases it may be necessary to provide a false floor or ramps over the tracks to allow for the movement of trolleys or to guard against staff tripping over the tracks. If so, this should be done after the tracks have been laid and before the shelving is installed. In selecting leased premises attention should be paid to floor levels where mobile shelving is to be used.

It cannot be overstated that the placement of shelving tracks is critical in ensuring optimum storage capacity and efficient use of shelving. This is particularly the case if non-standard shelving is to be used.

Australian Archives uses vinyl floor coverings laid over the entire storage surface. Bare concrete is not acceptable as the dust given off will contaminate the records and pollute the air-conditioning system. This is one feature that has not changed over the past twenty-five years. As a variation, however, both Kingswood and Runcorn have painted surfaces rather than vinyl; Runcorn experienced problems with the original painted surface and another product had to be applied.

Many of the elements just discussed are both difficult and expensive to achieve and maintain, but costs must be weighed against the long term value of the information being preserved.

Air-conditioning

Kitching states that building columns are the bane of the archivist's life.[18] This is not the case. The true bane of the archivist's life are air-conditioning systems. This is equally the case for facilities managers—both for those who plan them and those who use them. It is the one factor that must be right from the earliest design phase and yet it is the one that is almost always wrong. Even with today's technology, achieving appropriate environmental conditions is often a frustrating, expensive and time consuming task. Problems commonly seem to occur with vaults used for storing microfilm and motion picture film.

In recent times the effect of environmental conditions on record formats has been studied by Mathey,[19] Padfield,[20] Petherbridge[21] and others. It is now recognised that constant temperature and relative humidity can greatly assist records protection, regardless of the format. Added to this is the cleanliness of the air.

The achievement of appropriate environmental conditions is not just the responsibility of the air-conditioning plant. Other factors are also involved, as noted previously. It is imperative that storage areas are sealed to assist in the maintenance of temperature and relative humidity controls and prevent the intrusion of contaminants. There needs to be constant air movement throughout the storage areas as well as a fresh air intake of around 10 per cent per day.

There should be strict temperature and relative humidity controls wherever permanent value records are stored. This will not only apply to actual storage areas, but conservation laboratories and other areas where records may be held, even if on a temporary basis. Conditions should be monitored twenty-four hours a day and any deviations from set standards noted and acted upon.[22] While tolerances are indicated below they are by exception only and if a pattern of drift is established, even within the tolerances, action should be taken to return to stable conditions. The critical factor here is that conditions must not simply be created, they must be *constantly sustained.*

Appropriate temperature and relative humidity parameters vary according to the physical format of the records being stored. What are the appropriate parameters for each record format or medium is a question to which there is no universal answer. As research into the effects on environmental conditions has increased, appropriate parameters have generally decreased.

With respect to paper records, Duchein states that 18°C and 55% RH ±5% are appropriate;[23] BS 5454 nominates 13°–18°C and 55%–65% RH.[24] The Queensland State Archives has established 20°C and 50% RH as its parameters.[25] Australian Archives previously accepted parameters 20°C and 50% RH but is now designing to achieve 18°C and 45% RH. Achieving these conditions can be very difficult, if not impossible, in older facilities which are not effectively insulated and whose air-conditioning plant is outmoded. In order to achieve a reduction from 21°C to 18°C at its Collinswood facility, Australian Archives would be required to undertake works with an estimated cost of $500 000. A number of air-conditioning systems in Australian Archives facilities have, however, undergone refurbishment in order to meet these new parameters.

Whatever conditions are established, the air-conditioning system should be capable of sustaining these requirements at all times of the year. It is re-emphasised that temperature and relative humidity must remain constant; fluctuations in either can contribute to the degradation of records.

For low temperature storage, e.g. for audiovisual records, whilst there are no standards, there has been general agreement on appropriate parameters which range between 16–18°C and 30–40% RH. Australian Archives and the Queensland State Archives have both accepted 18°C and 45% RH as their standard.

The filtration system used is also of major importance. The system should be capable of filtering out 95% of dust particles up to two microns or greater. In addition, sulphur dioxide, vapours, odours and other contaminants should also be effectively filtered. In this respect activated carbon filters have proven to be very effective and are being introduced in all of Australian Archives' facilities. Acknowledgment of good filtration is not new; it was recognised by the Public Works Committee in its report for Villawood in 1970.[26]

It is also important to consider the location of the facility's principal air intakes. They should not be near the carpark. This may sound obvious but there are many office buildings which have a principal air intake located in or near the carpark and which thus collects all vehicle exhaust fumes.

Monitoring of environmental conditions

Monitoring of environmental conditions is vital and building management systems (BMS; to be discussed shortly) can assist in this regard. Thermohygrographs are a useful tool and can complement the BMS by monitoring conditions, although they can only operate in single units within a building or in a single area. This may no longer be adequate. What is now needed is a complete picture of conditions within an entire storage area and this is where the BMS is at an advantage with its wide array of sensors.

What has also been recognised in recent times is that there has been little consideration given to the monitoring of conditions inside the records container or film canister, i.e. the micro environment.[27] The size of monitoring equipment, e.g. thermohygrographs, has generally precluded this from being done except for the largest types of containers. With the advent of portable dataloggers over the past decade it is now possible for micro conditions to be extensively monitored. It is still too early to predict the outcome but it may be that micro conditions will remain stable even if macro conditions fluctuate. If this does occur, it could herald a rethinking in macro parameters.

Building management systems

One of the major changes over the past twenty-five years has been the advent of building management systems. These systems evolved through the use of direct digital controls and are a means of computerised monitoring and controlling many facets of a building's operations. They can monitor environmental conditions (temperature, humidity, sulphur dioxide levels) in the storage areas and control the operation and sequence of the air-conditioning system to sustain the requisite environmental conditions. They allow a much greater flexibility and control over these conditions than has previously been the case. With the aid of portable computers and modems the facility's manager can now actually monitor environmental conditions within a building even if located thousands of miles away. It is possible to control an air-conditioning plant or lighting system without actually entering the building.

They have been included in a number of new facilities such as East Burwood and are now being fitted retrospectively to other Australian Archives' facilities. Other institutions, including the Queensland State Archives and the National Library of Australia, also have such systems.

These systems are not limited to controlling a building's air-conditioning plant. They have the capacity to control all aspects of a facility's lighting, fire protection and security. They can also monitor a building's energy efficiency. In essence, they represent a major technological impact on the operations of a purpose built facility, one of the most significant in the last twenty-five years.

Fire detection

Given the irreplaceable nature of the material held within a repository, it follows that fire protection—both in detection and suppression—is paramount.

The following are considered to be the minimum requirements for a modern purpose built repository. As with many other features, they have evolved progressively over the past twenty-five years:

- there should be a central alarm panel with direct connection to the local fire brigade;

- depending on the size of the building, it may be necessary for it to be compartmentalised with automatic fire doors (connected to the central panel) separating each compartment; buildings today tend to be more

compartmentalised than previously; this not only assists with fire protection but maintaining a conditioned environment;

- the air-conditioning system should be connected to the central panel so that in an emergency the system shuts down automatically and a smoke evacuation system comes into operation;

- smoke exhaust systems are designed to quickly expel smoke from a building; research has shown that in the event of a fire the real risk to people is the smoke, not the flames; and

- smoke and heat detectors should be located at appropriate points, each connected to the central panel.

If highly sensitive records are to be stored, consideration is often given to the installation of a VESDA [Very Early Smoke Detection Apparatus] system. VESDA is a recent Australian invention and has proven to be a most reliable form of early fire detection. But a word of warning—if extensive cleaning of a storage area is planned, switch the VESDA off. They are so sensitive that they are likely to be activated by dust particles.

Fire suppression

Internal fire hoses and extinguishers should be installed at appropriate points, in accordance with local and national standards.

All storage areas should be fully 'sprinklered' with the system connected to the central panel. This criterion does not have universal acceptance. It is not a requirement of BS 5454 for example and is certainly not a requirement of law or any Australian standard. Australian Archives' adherence to this principle, however, has never wavered and it should be noted that Runcorn and the recent extension to Kingswood also conform to this practice.

Apart from the cost, one of the major objections to sprinkler systems is the possibility of accidental discharge. This is, however, a remote possibility. Technology has advanced so that there are a number of different types of sprinkler systems now available, including wet pipe and dry pipe. There is also an 'on-off' sprinkler system; once the temperature drops below a predetermined level the sprinklers switch off automatically. It must be noted that these latter systems are considerably more expensive than conventional sprinklers. In any event, even if there was an accidental discharge, wet records are easier to restore than burnt ones.

In one respect advances in technology have actually helped to reduce construction costs. The design of Villawood included provision for underground water storage tanks with a capacity of 100 000 gallons. The theory was that in the event of a fire and the loss of mains pressure the tanks could be brought into service. Nowadays this is recognised as both costly and excessive and a simpler alternative can be the use of multiple connections to the main water supply.[28]

College Park has adopted a most interesting strategy as part of its fire protection program. In the silent hours all shelving units open a few millimetres so that if the sprinklers are activated, water will be able to reach inside the shelving, putting the fire out quickly. As College Park uses electrically operated shelving it is an easy task to do this; most institutions which use manually operated shelving would be faced with major problems in opening all shelving units at night and closing them the next morning.

Gas Flood Systems

Depending on the physical nature of records being stored, and their sensitivity, consideration has often been given to the use of gas flood systems in small storage areas such as film vaults and security vaults.

The impact of technology over the past twenty-five years is shown to perfection here. The most commonly used gases have been carbon dioxide or halon. Carbon dioxide can only be used with care as it is potentially life threatening to any persons in the area being protected. This gas was installed at Villawood but all other Australian Archives' facilities had halon gas installed. Halon evolved as a low cost alternative to carbon dioxide, but it has been shown to damage the ozone layer and has now been phased out of all Australian Archives' facilities in line with Commonwealth Government policy.

At present the only viable alternative to gas is a combination of sprinklers and VESDA. This combination has been used at East Burwood, Runcorn and Portside. The loss of halon has seen the development of a number of replacement gases but as yet there is no satisfactory 'drop-in' replacement.

Formal fire surveys should also be undertaken at regular intervals to ensure that the facility maintains its fire protection capability. It is the practice of Australian Archives to hold such surveys every three years.

Security

The level of security to be considered in a purpose built repository depends on the sensitivity of records held or their potential value to unauthorised users. Technology has reached a stage where intruder penetration can now be detected through a variety of devices connected to a central alarm panel. This panel is in turn connected to a monitoring point.

Typically, all external perimeter openings (doors, windows, loading bay doors, etc.) are fitted with reed switches connected to the panel. Motion detectors are placed at strategic intervals throughout the building and storage areas. It may also be considered necessary to install cameras in storage areas with monitors located in staffing areas, or back to a central monitoring point.

Entrance doors to storage areas should be locked with only appropriate staff having access. This can be controlled through traditional keying or there are a wide variety of electric access systems available, eg swipe cards, proximity cards or key cards.

Security not only includes the building but should include its surroundings as well. The construction of a security fence around buildings generally acts as a deterrent to vandals and those intruders seeking an easy target for petty theft. In this context site selection again becomes significant. Consideration should be given to patrols of the site in the silent hours unless there is a guard or caretaker in residence.

Security survey

A formal security survey should be undertaken every five years and should include a threat evaluation. Threat evaluation involves making judgements about the likelihood or probability of an event taking place that could adversely affect an organisation's resources. It is used to determine if there is a threat, where it is likely to come from and how it might be realised. Threats can be accidental, e.g. fire, flood, equipment failure or negligence. They can also be deliberate, e.g. theft, sabotage, espionage, unauthorised disclosure, disruption to operations. These deliberate threats can emanate from dishonest or disgruntled employees or members of the public, criminals or terrorists. If the following three factors, i.e. intention, capability and opportunity, are present and operating together then a deliberate threat may actually happen. Any assessment of deliberate threats must address the intention (e.g. plan) and capability (e.g. human, technical and financial resources, knowledge) of individuals or groups to cause harm. Opportunity depends on the reliability

and efficiency of the organisation's existing protective security arrangements and measures.

In short, whilst the possibility of nuclear threat has diminished dramatically, the possibility of other acts of violence remains very real.

Lighting and Power

Natural light should not be allowed to enter storage areas, regardless of whether they house permanent or temporary value records. For this reason it is desirable that there be no windows or skylights in storage areas. As stated earlier, whilst there is still debate and disagreement on this subject, storage areas are intended for records, not people, and records do not require a view of the surrounding countryside.

Overhead light fittings in storage areas should be arranged so that they run perpendicular to the direction of travel of mobile shelving units. This ensures that there is appropriate lighting in all rows of shelving. Artificial lighting in storage areas is adequate at around 200 lux.[29] Light fittings should be fitted with diffusers. Additionally, lighting in permanent storage areas should have ultraviolet filtering. Tests conducted during the design of Runcorn showed that certain types of diffusers can actually filter out ultraviolet light to an acceptable level.

In recent times great emphasis has been given to energy management (as will be discussed shortly) and in response to this issue many institutions have had time switches connected to their light fittings, both to save electricity costs and to reduce the amount of light in the storage areas. Such devices can be controlled through a building management system. An interesting innovation in this regard is the Queensland State Archives' use of motion detectors and infra-red beams to control the lighting in storage areas. If a person enters an area motion detectors will activate lighting in the corridors; entering a row of mobile shelving breaks the infra-red beam and this too activates the lighting above the shelving unit. The lights remain on for ten minutes (although this period is adjustable), however, a manual override system can ensure lighting for longer periods.[30]

Depending on the nature of the records held, it may be necessary for the facility to be fitted with an emergency generator to ensure uninterrupted power in the event of a failure in the mains supply. This should only be necessary in the event of power outages being likely to exceed forty-eight hours. Most modern facilities—including Villawood, Kingswood, East Burwood and Runcorn—have emergency power units.

Integrated pest management

It is of course axiomatic that purpose built facilities must remain free of unwanted pests such as silverfish, cockroaches, spiders and mice. By achieving such conditions, archivists protect both the records for which they are responsible and accountable, and help to maintain a safe and healthy working environment for both staff and visitors.

Modern literature stresses the importance of an overall integrated pest management program.[31] It is no longer sufficient to regard fumigation as the sole means of pest control. An integrated program comprises elements such as regular inspections for the presence of pests, deployment of non-chemical control measures, use and deployment of traps, evaluation of results and application of fumigants. If there is a pest infestation which cannot be resolved by other means, it may be necessary to apply fumigants. They should not be used, however, simply as a matter of course nor should fumigation be allowed to become a routine event. It should only be carried out whilst there is considered to be a genuine need.

With far greater emphasis now given to occupational health and safety issues (as will be discussed shortly), it needs to be remembered that fumigants—no matter what their level of toxicity may be—require extreme care in their handling and use. It is essential when applying fumigants indoors that stringent safeguards are observed to ensure that staff and visitors are not exposed to any risk to their health. The use of fumigants should only to be undertaken by experienced and licensed contractors. Fumigants should not be used by staff.

Shelving and containers

Given today's austere times it is imperative that storage areas make the maximum use of shelving to ensure the greatest quantity of records can be stored in a given space and, at the same time, to allow for ready access to the records and safe usage of the shelving by staff. Mobile shelving assists in this regard. There are a number of different types of shelving available, including friction drive, positive drive and electrically operated, the latter being the most convenient for staff to use, yet is the most expensive.

Australian Archives uses bays which are 2 475 mm high (excluding the bases), 900 mm wide and 400 mm deep. This enables the provision of eight shelves per bay and allows for the storage of material such as standard files, registers, folders, books and index cards. Shelving can of course go much higher; 10 high and 12 high are not uncommon, however, there may be staff

resistance to these levels and there are also occupational health and safety aspects to consider. Shelving is also available for the storage of non-standard items such as magnetic tapes and films. If mobile shelving is to be used for these items the shelves should be lop-sided (with the front of the shelf one level higher than the back) to prevent items from falling during operation of the shelving.

If models or objects are to be stored then a variety of commercial options are available. A number of firms provide racking in a variety of materials and sizes which can accommodate most items. Plan cabinets (either six or ten drawer) are recommended for drawings, plans and posters. Such material is best stored flat rather than rolled. Racking is also available for long drawings. In this respect the Queensland State Archives has developed a system of cantilevered shelving which can store drawings and plans which may be many metres in length.

Over the past twenty-five years most institutions have adopted a series of containers in which to store records, and abandoned earlier practices of having items simply left on the shelves or wrapped in bundles. Containers provide greater protection and assist with the movement of records. Until recently most containers were produced from cardboard and paper, or similar materials. Australian Archives has recently entered into a joint venture with Visy Board Pty Ltd and Australian Paper for the development and production of a wide array of containers produced from acid-free materials at a low cost. This venture will ensure that permanent value materials are afforded greater protection at a reasonable cost.

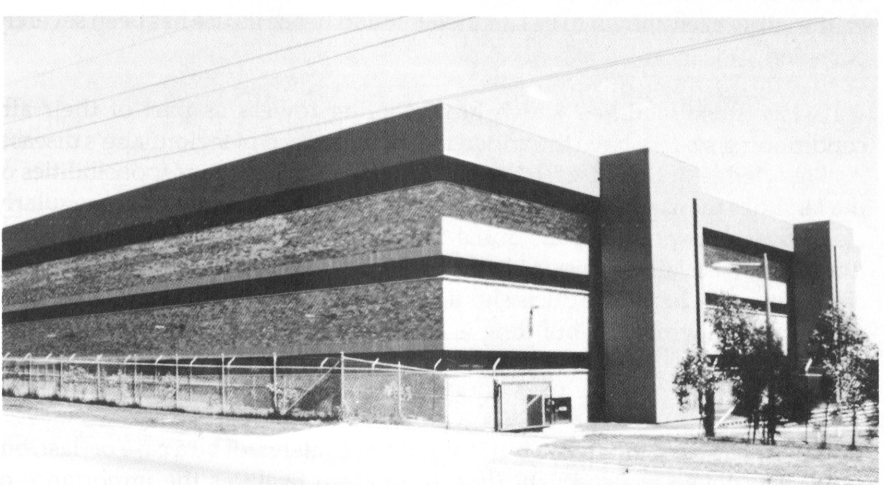
Environmental issues

Environmental issues were basically non-existent when Villawood was designed. In fact, the word 'environment' never appeared in the Public Works Committee's report on the Villawood project nor in submissions made to the Committee by the Archives and the Department of Works. Today, however, these issues have assumed far greater prominence. Thus, following passage of the *Environment Protection (Impact of Proposals) Act 1974* Commonwealth agencies are expected to include an environmental impact statement as part of their proposals for new works. In its brief for East Burwood Australian Archives was required to seek input from both the then Department of Arts, Sport, the Environment, Tourism and Territories as well as the Australian Heritage Commission. The Public Works Committee noted the minimal impact the project would have when compiling its report.[32]

Two of the major environmental issues which affect the purpose built repository of today are energy management and the removal of chlorofluorocarbons.

Energy management is now paramount, so much so that Commonwealth agencies are required to include references to this subject as part of their annual reports. Purpose built repositories with air-conditioning plants operating twenty-four hours a day and large expanses of lighting are, of course, significant users of power. The prominence given to energy management has led to the controlled use of lighting in storage areas, assessment of tariffs available from electricity suppliers and the detailed monitoring of energy accounts. As stated earlier, building management systems have assisted greatly in efficient energy usage. Indirectly, energy management has also led to changes in the design of facilities, modifications being made which help to ensure that conditions within a building—once established—can readily be sustained. These changes have included more efficient air-conditioning plant and a more effective use of insulation in both the ceilings and walls.

Chlorofluorocarbons are present in many repositories in three ways. The first two form part of the building's fire protection—gas flood systems (BTM 1301) and hand-held extinguishers (BCF 1211). The third is in the form of chiller refrigerants R11 or R12. Given the damage that halons have been shown to cause to the ozone layer, current Commonwealth Government policy



Australian Archives New South Wales State Office, Villawood Repository. Photo: Australian Archives.

states that such gases (both BTM and BCF) must be removed by 1 January 1996 unless a certificate of exemption has been granted. The removal date for refrigerants is early next century but is likely to be reduced.

Occupational Health and Safety

As environmental issues have come to assume far greater prominence, so too has occupational health and safety. This was recognised by the Commonwealth Government with the passage of the *Occupational Health and Safety (Commonwealth Employment) Act 1991*. OH&S issues do affect the purpose built repository of today. This is not surprising given the size of some of these facilities and the types of activities undertaken within them.

There are a number of potential dangers which may be found in older buildings, and may come to prominence if an attempt is made convert an existing facility for use as a repository. Two dangers in particular are polychlorinated biphenyls and asbestos. Polychlorinated biphenyls are found in capacitors in light fittings installed up to the mid 1970s. They have been discovered in a number of Australian Archives' facilities, e.g. Villawood and East Victoria Park, and have since been removed. As for asbestos, it can be found as part of the lagging in air-conditioning ducts or as insulation in fire doors. Provided the material is contained there is no danger, however, problems occur when loose material can escape from confined spaces. Another danger is ethylene oxide which was once used in fumigation chambers. The gas has now been shown to be carcinogenic and hence its use has been severely curtailed.

Lastly, those facilities which have cooling towers as part of their air-conditioning system have the added risk of the spread of legionnaire's disease. As knowledge of this disease has expanded so too has the responsibilities of the facilities manager. The manager must ensure that the towers are regularly cleaned and inspected. Substantial penalties can be enforced if this is not done. Likewise, air-conditioning ducts should be inspected regularly as they can harbour bacteria. The ducts should be cleaned every 5–10 years, depending on the area in which the building is located.

Maintenance

This item has been left to last but it should definitely not be a case of 'last, but not least'. Given the sophistication of modern facilities the importance of ongoing maintenance should not be underestimated.

Once the repository is in operation a comprehensive maintenance program is needed. This involves an identification of all assets within a facility—both internal and external—including the building's fabric and surrounds and its mechanical, electrical, fire and security systems. When this has been completed appropriate maintenance schedules should be established and executed. There are a number of Australian standards which are of assistance in this regard, such as:

AS1735.10 1986 *SAA Lift Code-Tests*

AS1851.1-11 1981-1991 *Maintenance of Fire Protection Equipment*

AS2201.1 1986 *Intruder Alarm Systems*

AS2293.2 1986 *Emergency Evacuation Lighting in Buildings*

AS3666 1989 *Air-handling and Water Systems of Buildings-Microbial Control*

AS3676 1989 *Portable Fire Extinguishers-Guide to Servicing.*

Contracting out of maintenance

As technology has changed so too has the way in which repositories are maintained. There is now an emerging trend to outsource maintenance activities. Many companies are available to do this work and it is not uncommon for institutions to enter into comprehensive maintenance contracts with these companies. Computerised maintenance software programs are also flourishing. There are presently over forty such packages available.

Maintenance itself is changing. It is no longer the case whereby the facilities manager simply selects a contractor (often the relevant government works authority) and entrusts maintenance to that contractor who performs regular maintenance on the basis of time-controlled intervals. Considerable thought is now being given to a wide array of maintenance philosophies, e.g. Total Quality Maintenance, Reliability Centred Maintenance and Condition Based Maintenance. So prolific are these new philosophies and their associated acronyms that they have even spawned their own collective acronym to identify them, i.e. TLAs (Three Letter Acronyms).

The facilities manager must now be involved in the development of an appropriate maintenance framework which ensures that the building provides the conditions necessary for records protection and that there is a safe and comfortable environment for staff and visitors.

Conclusion

What the foregoing comments have hopefully demonstrated is that the purpose built repository of today is a highly complex structure, comprising many sophisticated elements. The facility is expected to perform a range of functions, all of which revolve around the long term preservation of permanent value records. How the facility actually operates has changed substantially over the past twenty-five years and is likely to continue to do so in the future. Changes in technology, increased monitoring of micro environmental conditions and greater emphasis on the environment generally and on OH&S matters will ensure that the facility continues to evolve. The people who design, build and operate these facilities will need to ensure that they remain aware of these changes if their facility is to perform at its maximum capability.

Endnotes

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5 British Standard Institution Standard 5454, *Recommendations for the Storage and Exhibition of Archival Documents*, London, 1989, p. 2.
6 Duchein, op. cit., p. 26.
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8 My thanks to John Burke from the Government Records Repository at Kingswood for this expression.
9 Vicki Warden, *The New Queensland State Archives Building*, paper presented to the Conference of the Australian Society of Archivists, Townsville, 1994, p. 1.
10 See Duchein, op. cit., p. 27 for the contents of a user brief.
11 ibid., p. 29-30 where Duchein presents some of the merits of using older buildings.
12 In this context Kitching, op. cit., pp. 20-22 discusses the merits of 'high thermal inertia', a process designed to achieve minimal responses to changing environmental conditions by using 'materials of high thermal mass combined with generous insulation' (p. 20).
13 Duchein, op. cit., pp. 111-112.
14 BS 5454, op. cit., p. 4.
15 Kitching, op. cit., pp. 28-30.
16 BS 5454, op. cit., p. 3.
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26 Parliamentary Standing Committee on Public Works, *Report relating to the proposed construction of an Archives Repository at Villawood, New South Wales*, Canberra, 1970, p. 13.
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29 Appropriate lighting levels are outlined in AS1680-1990, p. 16.
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- Ross Harvey, 'Preservation', in *Keeping Archives*, ed. Judith Ellis, D. W. Thorpe, Melbourne, 1993, pp. 86-88;
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32 Parliamentary Standing Committee on Public Works, op. cit., p. 23.