



2009 Victorian Bushfires  
Royal Commission

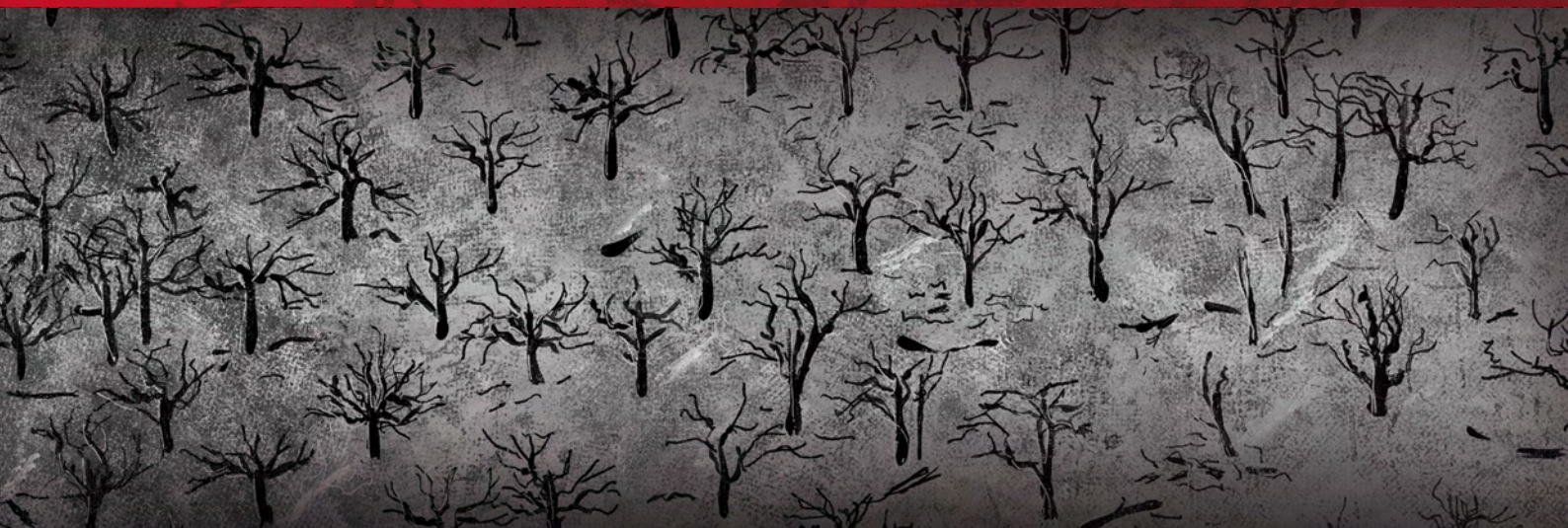
An aerial photograph showing a dense forest of dead, blackened trees, likely the result of a bushfire. The trees are silhouetted against a lighter, textured background.

# INTERIM REPORT 2

**PRIORITIES FOR BUILDING  
IN BUSHFIRE PRONE AREAS**

NOVEMBER 2009





The painting on the front cover, *Mountain Ash*, is by Kinglake artist Linda Haggard.

When the inferno swept through Kinglake on Black Saturday, Linda was at home with her husband Wayne. Her eldest daughter Kristin and husband, Heath, and their two children, 14-year-old Shelby and 12-year-old Oscar, were also with Linda.

While the adults successfully fought the blaze, Linda's grandchildren comforted the family's two pet dogs and a cat. All survived.

Linda was inspired to paint *Mountain Ash* when she flew over her property in a helicopter and viewed the devastated landscape below.

The Commission thanks Linda Haggard for making *Mountain Ash* available for reproduction on the cover of this report.

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**2009 VICTORIAN BUSHFIRES ROYAL COMMISSION**  
**INTERIM REPORT 2**  
**PRIORITIES FOR BUILDING IN BUSHFIRE PRONE AREAS**

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**2009 Victorian Bushfires  
Royal Commission**

Professor David de Kretser, A.C.  
Governor of Victoria  
Government House  
Government House Drive  
Melbourne VIC 3004

Dear Governor

In accordance with the Letters Patent dated 16 February 2009, and further to our Interim Report of August 2009, we have the honour of presenting to you additional recommendations regarding priorities for building in bushfire prone areas.

Dated this 24th day of November 2009.

**The Honourable Bernard Teague AO**  
Chairperson

**Ronald McLeod AM**  
Commissioner

**Susan Pascoe AM**  
Commissioner

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# PRIORITIES FOR BUILDING IN BUSHFIRE PRONE AREAS

## INTRODUCTION

- 1 The 2009 Victorian Bushfires Royal Commission (the Commission) was established on 16 February 2009 with broad terms of reference to investigate the causes of, preparation for, responses to, and impact on infrastructure of the fires that occurred in late January and early February 2009.
- 2 The Commission delivered its interim report on 17 August 2009. The interim report detailed the establishment and operation of the Commission, provided an overview of the February 2009 fires and made recommendations on actions that should be taken prior to the 2009–10 bushfire season.<sup>1</sup>
- 3 The work of the Commission, including the formal hearing process, is ongoing. Its final report is due by 31 July 2010.
- 4 The Commission's terms of reference require that it consider and make recommendations on 'the fireproofing of houses and other buildings, including the materials used in construction.'
- 5 In August and September 2009, the Commission heard evidence from a range of witnesses, including experts and lay witnesses, about construction of buildings in bushfire prone areas. This evidence explored in detail the designation of bushfire prone areas for the purpose of building controls and the requirements for construction in bushfire prone areas imposed by the Building Code of Australia (BCA), including the development and adequacy of Australian Standard AS3959 – *Construction of Buildings in Bushfire-Prone Areas* (AS3959), which is adopted by the BCA.
- 6 The majority of the issues arising from this evidence will be considered in the Commission's final report. However, a number of critical matters emerged that require urgent attention, well before the Commission presents its final report in July 2010.
- 7 On 21 September 2009, the Commission indicated its intention to make interim recommendations on the following urgent issues:
  - the regulation of bushfire bunkers
  - revision of some aspects of Australian Standard AS3959-2009 – *Construction of Buildings in Bushfire Prone Areas*
  - revision of the Standards Australia Handbook HB36 – *Building in Bushfire Prone Areas*.<sup>2</sup>
- 8 Since this announcement, the Victorian Government and other organisations have moved promptly to pledge action on some of these important issues. Of particular note is the announcement by the Australian Building Codes Board (ABCB), on 24 September 2009, that it will begin work immediately on a national standard for the design and construction of bushfire bunkers for personal use, with a view to completing the standard within six months. The ABCB has also undertaken to classify bunkers as a structure according to the BCA, though no time frame has been set for this.<sup>3</sup> On 11 November 2009, the Building Amendment (Private Bushfire Shelter Construction) Interim Regulations 2009 (Interim Regulations) introduced interim arrangements for the construction of bunkers in Victoria while the national standard is being developed and the BCA amended.<sup>4</sup>
- 9 The Commission welcomes these commitments and early actions, but considers that they, as well as the other matters detailed in this report, need to be converted into action quickly.

## BUSHFIRE BUNKERS

- 10 Various structures or rooms have been referred to in evidence before the Commission as fire refuges, bunkers or shelters. This report and recommendations focus specifically on 'bunkers' or 'bushfire bunkers', which are purpose built structures, for private use, that are intended to provide temporary shelter for people from a bushfire during the passage of the fire front.<sup>5</sup> These structures may be above or below ground, but are separate from a house, and should be distinguished from a cellar under a house or a safe room within a house.<sup>6</sup>

### BENEFITS AND RISKS

- 11 The Commission has heard from several witnesses who successfully sheltered from the fires on 7 February 2009 in a bunker or a bunker-like structure. For example:
- Mr Bevan Gobbett of Clonbinane took refuge with his wife and daughter inside their bunker, a disused shipping container buried into the side of a hill next to their house, about 20-25 metres from the house itself. Once inside, they wore charcoal resistant face masks.<sup>7</sup>
  - At his St Andrews property, Mr Jim Baruta designed and built a bunker into the ground in the side of a hill behind the house, with walls of concrete bricks, a concrete roof and a steel door. He sheltered in the bunker for a short time, perhaps five to ten minutes, while the fire front passed.<sup>8</sup>
  - Mr Andrew Berry, also of St Andrews, designed and constructed a concrete bunker, with a fireproof door, as his family's 'Plan B', near their house next to their water tank. Mr Berry, his wife and their young son sheltered in the bunker after their house caught fire, and remained in the bunker for about 30 minutes.<sup>9</sup>
- 12 Based on these accounts, it would appear that a well designed and constructed bunker can provide shelter from a bushfire while the fire front passes, and can be a useful 'Plan B' when efforts to defend a house have failed, or when for some reason it has not been possible to leave the property.
- 13 However, these accounts also contain notes of caution. Mr Baruta reported that, while sheltering in his bunker, smoke poured in through a small gap around the door, he felt faint and had difficulty breathing.<sup>10</sup> Mr Gobbett described how frightening the experience was for him and his family.<sup>11</sup> Mr Berry spoke of smoke entering the bunker, making the conditions inside uncomfortable and unpleasant.<sup>12</sup>
- 14 Other evidence before the Commission indicates that taking refuge in a bunker or in a space underneath a house may be extremely dangerous. Some of the difficulties faced by one witness who survived included difficulty breathing and having to escape from the space in extremely dangerous circumstances, before the house became fully ablaze.<sup>13</sup>
- 15 The Commission also heard evidence that seven people died in bunkers or bunker-like structures on 7 February.<sup>14</sup> For example:
- a Humevale man died in a purpose built bunker.<sup>15</sup> The first responding police officers observed that the inside of the refuge appeared similar to an oven, containing burning hot embers. The roof had collapsed and the sprinkler system on the roof had melted.<sup>16</sup>
  - a man and a woman died in Arthurs Creek as result of carbon monoxide toxicity while sheltering in a cellar.<sup>17</sup>
- 16 This evidence indicates that extreme caution should be taken in the use of bushfire bunkers as part of a household's fire plan. While a well designed and constructed bunker may provide a temporary place of refuge during the passage of the fire front, bunkers are not a panacea. Misplaced reliance on a bunker can be life threatening. For those situations in which a bunker is a viable option as part of an overall fire plan, the evidence to date suggests that the design, siting and construction of a suitable bunker are neither simple nor inexpensive.

- 17 In its *Draft Discussion Paper on Bushfire Bunkers for Residential Homes*, the Australasian Fire and Emergency Service Authorities Council (AFAC) identified some of the complex considerations surrounding the use of bunkers as a bushfire safety measure:

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*It is critical that bunkers are not seen or used as a simple solution to living in bushfire prone areas; they are only one part of a holistic fire management approach that may provide an additional level of redundancy. A bunker must not be relied upon as the only alternative to mitigate the impact of bushfires in fire prone areas. An appropriately constructed building incorporating bushfire protection measures should be promoted in all circumstances. Bunkers may be a worthy consideration but only in situations where other passive protection measures cannot be reasonably used to mitigate the impact of a bushfire. They should be seen as the last resort.*

...

*The initial perception is design and construction principles for a bunker are relatively straightforward. However, matters such as location relative to the residential house, proximity to other fire source features (vegetation, houses, sheds, wood piles, fences etc), management of a confined space, clean air management and maintenance of bunkers make the safety issues associated with a bunker highly complex and potentially life threatening, particularly if the bunker is not properly maintained during non-bushfire periods.<sup>18</sup>*

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- 18 The State of Victoria (State) also notes that:

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*... if personal fire refuges are to be used by individuals they should only be seen as options of last resort. The existence of a personal fire refuge should not preclude a person from planning to leave on days with a Fire Danger Rating of Severe, Extreme or Code Red (Catastrophic). Personal fire refuges are not, and should not be relied upon, as a substitute for adequate preparation of an existing home and appropriate mitigation measures at the planning and building stage of a new home.<sup>19</sup>*

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- 19 The positions of AFAC and the State are consistent with the evidence of a number of witnesses who gave evidence before the Commission.<sup>20</sup> The Commission accepts and adopts this as a sound approach.

## DEMAND AND SUPPLY

- 20 There has been a significant demand for bushfire bunkers since 7 February. Victoria's Building Commissioner, Mr Tony Arnel, referred to the 'huge amount of interest in the matter of personal fire refuges, bushfire bunkers, if you like, since 7 February.'<sup>21</sup> Mr Arnel's assessment is confirmed by a targeted survey of suppliers of bunkers, conducted by the Commission's research team. Industry participants surveyed reported that interest in and demand for bunker products had increased significantly since 7 February, and remained steady.<sup>22</sup>
- 21 Mr Arnel also noted that there were a number of products on the market with little or no verification.<sup>23</sup> Submissions received by the Commission from the public and an internet based review conducted by the Commission's research team confirmed that there was a wide range of bunker products either available for purchase or in development.<sup>24</sup> While some suppliers made explicit statements that there is no existing standard for bunkers, a number of others claimed that the bunker or its components complied with Australian Standards. Such reference to Australian Standards incorrectly implies the existence of a standard for bunkers, and may contribute to exaggerated confidence in the safety provided by a bunker.<sup>25</sup>
- 22 This was confirmed by the Australian Competition and Consumer Commission, which made a public statement on 13 October 2009 raising concerns that 'some web-based advertising may have given consumers the impression that there was an Australian Standard for bushfire bunkers which their product met' and noting that it had raised these concerns directly with three traders.<sup>26</sup>



## REGULATION

- 23 Until very recently, there was effectively no regulation of bushfire bunkers in Australia. Before Victoria introduced interim arrangements on 11 November 2009 (see paragraphs 26–27 below), there were no minimum standards for the construction of bushfire bunkers prescribed by law in Victoria, or elsewhere in Australia.<sup>27</sup> Bunkers do not readily fall within one of the existing BCA classifications, and so are generally not subject to the existing minimum construction standards prescribed by the BCA.<sup>28</sup> Bunkers are not addressed in *AS3959-2009 – Construction of Buildings in Bushfire Prone Areas*.
- 24 In light of the evidence before the Commission of the potential risks of misplaced reliance on bunkers, the demand for bunkers and the widespread availability of bunker products, the absence of any prescribed minimum standard for the design, siting and construction of bunkers is of grave concern.
- 25 In August 2009, the Building Commission published a Community Information Sheet on bushfire bunkers, which advises that a bunker may not be a safe option in all cases. It notes that there are currently no technical standards for the manufacture of bunkers or standards for their construction, so that none of the products currently available have been tested against a recognised standard. It outlines a number of considerations for those considering a bushfire bunker and advises people to seek professional advice, and to view a bunker as part of an overall fire plan rather than a simple solution.<sup>29</sup>
- 26 On 11 November 2009, the Governor in Council made Interim Regulations under the *Building Act 1993* (Vic), which will expire on 10 November 2010, and provide for:
- the classification of ‘private bushfire shelters’ as a class of building, which will trigger a requirement to obtain a building permit for such a structure (private bushfire shelters are defined as ‘a building or part of a building that may, as a last resort, provide shelter for people from the immediate life threatening effects of a bushfire’)<sup>30</sup>
  - interim performance requirements for private bushfire shelters associated with single residential dwellings (Class 1 Buildings)<sup>31</sup>
  - the Building Regulations Advisory Council to accredit private bushfire shelters<sup>32</sup>
  - maintenance requirements for occupants of allotments or buildings containing private bushfire shelters.<sup>33</sup>
- 27 Product manufacturers will be able to seek the Building Regulations Advisory Council’s accreditation of their products, and consumers will either need to purchase an approved product, or satisfy a building surveyor that an alternative design meets the interim performance requirements.<sup>34</sup>
- 28 The Commission agrees that it is important that people who wish to install bunkers before the national standard is developed should be able to do so with adequate information and assurance about a product’s safety. While the Commission has not had the opportunity to hear evidence about the nature and operation of the Interim Regulations, it welcomes the actions of the State to develop an interim solution.
- 29 However, it is noted that the Building Regulations 2006 (as amended by the Interim Regulations) include performance requirements that have not been recommended by the Commission (at paragraph 34), such as the requirement for the design and construction of bunkers to provide for ‘appropriate sanitation and other measures’.<sup>35</sup> The Commission cautions that performance requirements should be commensurate with the purpose of the structure, which is to provide short-term accommodation during the passage of a fire.
- 30 The Commission notes that the Building Commission intends to conduct half day seminar workshops in Traralgon, Whittlesea and Melbourne, but suggests that further consultation, awareness raising and training activities will be required to support the introduction of the interim arrangements in the first instance, and to ensure a smooth transition once the interim arrangements lapse.<sup>36</sup>

## A STANDARD FOR BUNKERS

- 31 It is clear that a minimum standard for bunkers must be developed as the basis for regulating their design, siting and construction, and that this should occur immediately.
- 32 A number of paths for the rapid development of a standard were proposed in evidence to the Commission, including:
  - a fast-tracked Standards Australia process<sup>37</sup>
  - development of a standard by the ABCB, with the involvement of a wide range of stakeholders, in accordance with its protocol for the referencing of technical documents<sup>38</sup>
  - a different process that would see 'some performance criteria built into the Victorian regulations within a relatively short period of time.'<sup>39</sup>
- 33 On 24 September 2009 the ABCB announced its intention to begin work immediately on a national standard for the design and construction of bushfire bunkers to be developed within six months.<sup>40</sup> This approach has received support from the State, the Commonwealth, AFAC and Standards Australia.<sup>41</sup>
- 34 The ABCB advises that, consistent with the evidence before the Commission, and the issues identified by Counsel Assisting the Commission in its submissions, the standard will include the following matters:
  - **Fire resistance.** A bunker should shield occupants from direct flame contact, radiant heat and embers and should be constructed from materials that will withstand bushfire conditions.<sup>42</sup>
  - **Structural strength.** A bunker should be sufficiently strong to withstand the impact of windblown objects and falling trees and, in the case of in ground bunkers, vehicles driving over the bunker.<sup>43</sup>
  - **Resistance to high winds.** A bunker should be designed and constructed to withstand the high winds that are a feature of extreme fire weather.<sup>44</sup>
  - **Maintenance of tenable conditions.** It is critical for a bunker to be designed and constructed so as to maintain tenable conditions for a sufficiently long time for occupants to shelter from the fire. A bunker should limit internal temperature increase, and ensure reasonable air quality for occupants. In relation to air quality, the relevant considerations include excluding smoke from the bunker, preventing the removal of oxygen by the fire and ensuring adequate oxygen levels for the period of occupation.<sup>45</sup>
  - **Minimum functional size.** The standard should specify the minimum functional size per occupant, or for a given number of occupants.<sup>46</sup>
  - **Maximum period of occupancy.** The standard should provide a means for calculating the maximum period for which a given number of people can safely occupy a bunker.<sup>47</sup>
  - **Visual communication with outside.** Occupants of a bunker must have some means of establishing whether and when it is safe to leave, for example by a fire resistant window.<sup>48</sup>
  - **Siting.** The standard should specify requirements for adequately separating the bunker from the house and any other fire hazards in the vicinity.<sup>49</sup>
  - **Access and egress.** A bunker should be designed and sited to ensure a safe path of travel from the house to the bunker, so that burning or collapsing structures and vegetation do not prevent egress after the fire front has passed.<sup>50</sup> The door of a bunker should be able to be readily opened from both inside and outside the bunker, so that people (in particular children) do not become trapped in the bunker.<sup>51</sup>
  - **Signage.** The standard should specify a method of signage for bunkers, so that emergency services and others can readily identify and locate a bunker.<sup>52</sup>
- 35 Ancillary matters, such as 'characteristics of occupants, and amenity issues including water supplies and sanitation', are also being considered for inclusion in the standard.<sup>53</sup>
- 36 The ABCB has confirmed that it is on track to develop the standard by 24 March 2010. Following its development, the ABCB intends to undertake broader stakeholder consultation and commission an international peer review before making the standard publicly available in April 2010.<sup>54</sup> The Commission welcomes and encourages this commitment by the ABCB and stresses the importance of meeting the six month deadline.



## RECOMMENDATION 1

The Australian Building Codes Board continue to progress the development of a standard for bushfire bunkers, that addresses matters including, but not limited to, fire resistance, structural strength, resistance to high winds, maintenance of tenable conditions, minimum functional size, maximum period of occupancy, visual communication with outside, siting, access and egress and signage, and make it publicly available no later than 30 April 2010.

## REGULATORY AMENDMENTS

- 37 The Commission believes that, as a matter of principle, building standards relating to bushfire risk should be applied nationally. The most effective way to ensure appropriate and consistent regulation of bushfire bunkers is to amend the BCA to include bunkers in the classes of building regulated by the BCA. The Commission welcomes the ABCB's announcement of its intention to do this and urges that this amendment should take effect with the publication of the 2010 edition of the BCA.<sup>55</sup> As the ABCB has committed to a 24 March 2010 deadline to develop a standard for bunkers, it should also be possible to reference the new standard in the BCA at the same time. The Commission notes the commitment by the Commonwealth to recommend, through the Building Ministers' Forum, that this occur, if the standard is developed within the proposed six month timeframe.<sup>56</sup>
- 38 In any case, the standard should be enacted in Victoria by amendment to the Building Regulations, no later than 31 May 2010. If the BCA is yet to be amended, the amending regulations should include objectives, a functional statement and performance requirements, suitable for later inclusion in the BCA.

## RECOMMENDATION 2

The Australian Building Codes Board amend the Building Code of Australia (BCA) to include bunkers in the classes of building regulated by the BCA. This amendment should take effect with the publication of the 2010 edition of the BCA.

## RECOMMENDATION 3

The Australian Building Codes Board reference the national standard for bushfire bunkers in the Building Code of Australia (BCA) as soon as possible, ideally in the 2010 edition of the BCA.

## RECOMMENDATION 4

The Commonwealth, through the Building Ministers' Forum, encourage all jurisdictions to adopt the standard for bushfire bunkers as soon as practicable once it is developed and/or referenced in the Building Code of Australia.

## RECOMMENDATION 5

The Victorian Government prescribe the national standard for bushfire bunkers as a minimum standard for Victoria by amending the Building Regulations 2006, no later than 31 May 2010.

## AS 3959–2009 – CONSTRUCTION OF BUILDINGS IN BUSHFIRE PRONE AREAS

- 39 The 2009 edition of AS3959 (AS3959–2009) specifies the construction requirements for buildings in bushfire prone areas to reduce the risk of ignition from a bushfire while the fire front passes. Construction requirements vary depending on the Bushfire Attack Level (BAL) specified for a property following a site assessment. There are five levels of BAL that require specific construction requirements:<sup>57</sup>

BAL–12.5	Low Risk	Risk of ember attack.
BAL–19	Moderate Risk	Risk of ember attack and burning debris ignited by wind borne embers and a likelihood of exposure to radiant heat.
BAL–29	High Risk	Increased risk of ember attack and burning debris ignited by wind borne embers and a likelihood of exposure to an increased level of radiant heat.
BAL–40	Very High Risk	Much increased risk of ember attack and burning debris ignited by wind borne embers, a likelihood of exposure to a high level of radiant heat and some likelihood of direct exposure to flames from the fire front.
BAL–FZ (Flame Zone)	Extreme Risk	Extremely high risk of ember attack and burning debris ignited by wind borne embers, a likelihood of exposure to an extreme level of radiant heat and direct exposure to flames from the fire front.

- 40 AS3959–2009 was published on the basis that some issues would require further consideration. The preface lists a number of issues for inclusion in future editions or as amendments.<sup>58</sup> Standards Australia has confirmed that this work would continue to be done using the Standards Australia driven pathway, which involves development by a technical committee, release for public comment, and a consensus based committee ballot.<sup>59</sup>
- 41 Mr Barry Eadie, Chair of the FP-20 Committee, which is responsible for AS3959, indicated that two amendments to the Standard were contemplated. The first is a number of editorial, non-technical corrections. The second amendment involves the FP-20 Committee looking at the 16 issues listed in the preface to the Standard and working out which of those can be resolved by the Committee, and which involve separate projects. The latter includes sprinklers and bunkers; the former includes issues identified by CSIRO and outlined in a report provided to the Commission by Mr Justin Leonard, Research Scientist, CSIRO Sustainable Ecosystems. Mr Eadie thought that some of those issues could be resolved by the Committee in a short time, within the next two meetings.<sup>60</sup>
- 42 It is apparent from the evidence before the Commission that there is a strong case for immediate revision of the Standard to address the following matters:
- inclusion of unmanaged grassland in the vegetation types and classifications
  - use of sarking as a secondary ember protection measure
  - increased ember protection measures at lower BALs, in particular in relation to subfloor requirements and materials prescribed for doors, windows and wall barriers.

### GRASSLAND

- 43 One of the issues identified for future editions and amendments to AS3959 is the inclusion of unmanaged grassland in the vegetation types and classifications in the Standard.<sup>61</sup> At present it appears that unmanaged grassland is not considered in assessing the BAL except in Tasmania.<sup>62</sup> The exclusion of grassland fuels from the 2009 edition of the Standard was criticised by Mr Leonard:



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*Although AS3959-2009 states that this is an issue for future editions (ref AS3959-2009 page 3 item (iv)), this standard has removed the requirement to consider grassland fuels as a fuel type that could threaten buildings. The previous standard AS3959-1999 (table 2.1 vegetation category F) required building prescriptions for certain grassland fuel exposures. There has been substantial evidence provided from recent fires highlighting the significant risks posed by grassland fuels adjacent to structures (Noble 1991, Rasmussen & Fogarty 1997, Fogarty & Alexander 1999, Gill 2005).*

*CSIRO is not aware of any evidence to support the relaxation of the requirement for grassland fuels adjacent to structures. The combined sensitivity of no requirements for sub-floor materials and the allowance of grassland fuels up to the structures would appear to weaken the standard's intent to reduce the risk of building ignitions.<sup>63</sup>*

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44 AFAC has made the same criticism.<sup>64</sup> The concerns of AFAC and CSIRO are shared by Paul England of Exova Warringtonfire, who was engaged by the Building Commission to comment on the relative stringency between the 1999 and 2009 editions of the Standard. The Building Commissioner accepts Mr England's opinion that there would be benefit in increasing the scope of the Standard to cover grasslands.<sup>65</sup>

45 There seems to be no reason for this issue not to be dealt with by an immediate amendment to AS3959.

## **SARKING**

46 The term 'sarking-type material' is defined at clause 1.5.23 of the Standard as:

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*A material, such as a reflective foil or other flexible membrane, normally used for a purpose such as water proofing, vapour proofing or thermal reflectance.<sup>66</sup>*

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47 The Standard provides, in relation to joints in external walls for BAL-12.5 through to BAL-FZ:

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*All joints in the external surface material of walls shall be covered, sealed, overlapped, backed or butt-jointed to prevent gaps greater than 3 mm.*

*Alternatively, sarking-type material may be applied over the outer face of the frame prior to fixing any external cladding.<sup>67</sup>*

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48 There is no prescription that sarking-type material used behind wall cladding, effectively as a secondary ember protection measure, should have any particular fire resistant qualities. Sarking specified for use under roof tiles and sheeting at BAL-12.5 to BAL-40 must have a minimum level of fire resistance (a flammability index of not more than 5).<sup>68</sup>

49 Three key concerns regarding sarking were raised by expert witnesses in evidence before the Commission. These concerns clearly require further consideration and resolution by the FP20 Committee as a matter of priority:

- Design should focus on the integrity of the external membrane of the building to reduce the likelihood of embers entering inaccessible spaces.<sup>69</sup> Sarking should not be used as an alternative to sealing gaps in cladding, but only as a backup if gaps occur.<sup>70</sup> At a minimum, the efficacy of using sarking to protect large openings against the entry of embers should be investigated to identify any significant hazard or method of building failure.<sup>71</sup>
- If sarking is to be permitted as a secondary ember barrier behind unregulated gaps (for example, behind wall cladding) it should have some minimum fire resistant properties.<sup>72</sup>
- Sarking with a flammability index of no more than 5 has not been tested to determine its performance as an ember barrier.<sup>73</sup> This means that a product may achieve this flammability index by melting away from the flame, so that if hot embers fall through gaps onto sarking the sarking may melt, allowing the embers to enter cavities.<sup>74</sup> If sarking is to be used as a secondary ember protection measure, only sarking that has a sufficient level of fire resistance to be an effective barrier should be prescribed.

- 50 The Commonwealth has observed that ‘there is a divergence of views’ about the need to address the use of sarking as a secondary ember protection measure, and the State’s view is that there is ‘a difference of opinion between the various experts’.<sup>75</sup> However this should not delay resolving this issue as a matter of priority. The Commission welcomes the recent advice of Standards Australia that the FP-20 Committee has established a working group on sarking and a timeline for developing a sarking amendment.<sup>76</sup>

### EMBER PROTECTION AT LOWER BALS

- 51 Post bushfire surveys in Australia have consistently found that most houses ignite and burn due to wind borne embers.<sup>77</sup> Mr Leonard described in his report the many ways in which embers can ignite a house and emphasised that the risk of ignition is related to the weak links in the design and construction of a house.<sup>78</sup> Unlike direct flame exposure and radiant heat flux, which are only expected at the highest Bushfire Attack Levels (BAL-40 and BAL-FZ), ember attack is a threat at all BALs where specific construction requirements are mandated (BAL-12.5 to BAL-FZ).<sup>79</sup> Hence, measures designed to prevent ignition by embers are key measures across the board.
- 52 Against this background, Mr Leonard expressed concern that AS3959-2009 provides for lesser ember protection measures for BAL-12.5 and BAL-19 in the areas of subfloors and material prescriptions for doors, windows and wall barriers than the previous version of the Standard (AS3959-1999).<sup>80</sup> Subfloors and doors have already been explicitly identified in the preface of the Standard as requiring further attention. The specific issues raised by Mr Leonard were:
- The Standard specifies at BAL-29 to BAL-FZ that subfloors are enclosed, or that subfloor supports meet minimum levels of fire resistance for each BAL, and that flooring materials need to meet minimum levels of fire resistance where the subfloor space is not enclosed.<sup>81</sup> There are no such ember protection requirements at BAL-12.5 and BAL-19. The Commission believes that Mr Leonard’s report is supported by sufficient research to justify including minimum subfloor requirements at the lower BALs.<sup>82</sup>
  - The Standard specifies timbers for doors, windows and wall barriers based on density for areas that may receive direct flame contact from accumulated embers in BAL-12.5 and BAL-19. Mr Leonard is of the view that timber density is not a good indicator of ignitability, and a more appropriate approach would be to specify timbers based on their fire performance.
  - AS3959-2009 permits the use of timber shutters at BAL-12.5 and BAL-19, unprotected timber windows and doors up to BAL-29 and the use of timber wall barriers for BAL-12.5 and BAL-19.<sup>83</sup>
- 53 The Commonwealth observed that ‘there is a divergence of views’ about the need to address ember protection at lower BAL levels, and the State considered that there is ‘a difference of opinion between certain experts’.<sup>84</sup> Standards Australia advises that the FP-20 Committee does not currently have sufficient evidence to adequately consider whether amendments to increase ember protection measures at lower BALs are warranted, and that any such revision would be necessarily more complex and lengthy than the grasslands and sarking amendments.<sup>85</sup>
- 54 However, the FP-20 Committee should not shy away from taking urgent action to address the matters relating to ember protection at lower BALs already identified in the preface to the Standard, as well as related matters outlined in this report. If the Committee requires further evidence referred to in Mr Leonard’s report, it should seek that information from CSIRO immediately.



## RECOMMENDATION 6

Standards Australia, no later than 31 March 2010:

- publish amendments to AS3959-2009 that address inclusion of unmanaged grassland in the vegetation types and classifications, and use of sarking as a secondary ember protection measure; and
- report to the Commission on progress of amendments to AS3959-2009 to increase ember protection measures at lower Bushfire Attack Levels, in particular in relation to subfloor requirements and materials prescribed for doors, windows and wall barriers.

## HB-36 – BUILDING IN BUSHFIRE PRONE AREAS

- 55 Many witnesses made the point that AS3959 should not be applied in isolation; that it is but one risk mitigation measure that should be applied as part of a holistic approach to managing bushfire risk. To this end, Standards Australia has previously published a handbook known as *HB-36 – Building in Bushfire Prone Areas* (the Handbook), which is a companion to the Standard. While the Handbook is not referenced in the BCA and compliance with the Handbook is not mandatory, it addresses a whole range of non-construction issues, such as planning, access, water supply and maintenance.<sup>86</sup>
- 56 The last edition of the Handbook was published in 1993, as a companion to 1991 version of the Standard (AS3959-1991), and is now very out of date.<sup>87</sup> Publication of a fully revised Handbook, for use as a companion to the 2009 edition of the Standard, should occur as a matter of priority.
- 57 Standards Australia has indicated that it is developing a new handbook that will replace HB36, which it expects to complete by 31 December 2009. While the FP-20 Committee will be consulted, the Handbook will ultimately be subject to peer review by a panel of experts with expertise in fields relevant to its content.<sup>88</sup> As the Handbook will not be subject to the public consultation and consensus requirements of the FP20 Committee, it is appropriate that the project is fast-tracked and delivered by 31 December 2009.

## RECOMMENDATION 7

Standards Australia publish a fully revised Handbook to replace *HB-36 – Building in Bushfire Prone Areas*, for use as a companion to AS3959-2009, no later than 31 December 2009.

## ENDNOTES

### INTRODUCTION

- 1 B. Teague, R. McLeod, S. Pascoe, 2009 Victorian Bushfires Royal Commission – Interim Report, Parliament of Victoria, August 2009. The report is available at [www.royalcommission.vic.gov.au](http://www.royalcommission.vic.gov.au)
- 2 Teague T7695:11–T7696:6
- 3 Exhibit 312 – ABCB Media Release (EXH.312.0002)
- 4 Submissions of the State of Victoria (RESP.3000.004.0001) at 0004–0007; Exhibit 500 – Response from the Building Commission dated 11 November 2009 (EXH.500.0003); Building Amendment (Private Bushfire Shelter Construction) Interim Regulations 2009

### BUSHFIRE BUNKERS

- 5 Exhibit 85 – Statement of Gledhill (WIT.025.002.0001) [75]; Exhibit 169 – Statement of Arnel, Annexure T (WIT.3000.002.0404) at 0408
- 6 Exhibit 169 – Statement of Arnel, Annexure T (WIT.3000.002.0404) at 0408
- 7 Exhibit 46 – Statement of Gobbett (WIT.026.001.0001) [7]–[10], [12]–[13], Attachment BG-2 (WIT.026.001.0009); Gobbett T1494:21–T1495:7; T1498:26–T1499:14
- 8 Exhibit 189 – Statement of Baruta (WIT.070.001.0001) [6]–[8], [23]–[28], [63]; Baruta T5973:1–T5976:3; T5979:14–T5979:23; T5984:3–T5985:27; T5995:2–T5996:3
- 9 Exhibit 195 – Statement of Berry (WIT.071.001.0001) [23]–[45], [70]–[77], [87]; Berry T6114:4–T6117:18; T6120:1–T6120:19; T6122:8–T6123:29
- 10 Exhibit 189 – Statement of Baruta (WIT.070.001.0001) [26], [63]; Baruta T5984:18–T5985:27
- 11 Gobbett T1499:7–T1499:14
- 12 Exhibit 195 – Statement of Berry (WIT.071.001.0001) [74]–[76]
- 13 Exhibit 224 – Statement of Cowdery (WIT.081.001.0001) [4], [13]–[18]; Cowdery T6856:5–T6856:30; T6858:2–T6859:12; T6862:15–T6866:31
- 14 Exhibit 215 – Statement of Hollowood (WIT.3010.003.0287) at 0287–0289; Hollowood T6637:20–T6656:7. The evidence relevant to these deaths is subject to Exclusion Orders dated 8 September 2009, 21 September 2009 and 29 October 2009.
- 15 Exhibit 216 – Autopsy report (SCV.006.001.0052\_R); Exhibit 186 – Statement of Gunningham (WIT.069.001.0001) [34]; Gunningham T5866:13–T5866:25
- 16 Exhibit 215 – Statement of Hollowood (WIT.3010.003.0287) [5]; Hollowood T6640:19–T6644:17
- 17 Exhibit 217 – Autopsy reports (SCV.006.001.0001\_R and SCV.006.001.0006\_R)
- 18 Exhibit 85 – Statement of Gledhill, Attachment 8 (WIT.025.002.0084) at 0089, 0090
- 19 Submissions of the State of Victoria (RESP.3000.004.0001) at 0002
- 20 See also Exhibit 85 – Statement of Gledhill (WIT.025.002.0001) [77]; Chladil T5459:2–T5459:18; Leonard T5553:23–T5553:31; Exhibit 175 – Leonard, Report to the 2009 Victorian Bushfires Royal Commission – Building Performance in Bushfires (TEN.066.001.0001) at 0063
- 21 Arnel T5210:31–T5211:2
- 22 Exhibit 290 – BRC Research, Bushfire Bunkers – A summary of products and concepts (TEN.089.001.0001) at 0007. See also Exhibit 290 – Letter to VBRC from VBRRA (CORR.0909.0022)
- 23 Exhibit 169 – Statement of Arnel (WIT.3000.002.0220) [228]
- 24 Exhibit 290 – BRC Research, Bushfire Bunkers – A summary of products and concepts (TEN.089.001.0001) at 0009–0096. See also Exhibit 290 – Letter to VBRC from VBRRA (CORR.0909.0022)
- 25 Exhibit 290 – BRC Research, Bushfire Bunkers – A summary of products and concepts (TEN.089.001.0001) at 0007. See also Exhibit 290 – Transcript of interview on ABC 774 between Red Symons and Craig Morrison of Fire Proof Shelters on 25 August 2009 (TEN.089.001.0047) at 0049–0050
- 26 Submissions of the Commonwealth (RESP.6001.001.0006)
- 27 Exhibit 85 – Statement of Gledhill (WIT.025.002.0001) [79]; Annexure T (WIT.3000.002.0404) at 0412; Arnel T5167:3–T5167:7
- 28 Arnel T5211:7–T5211:15; T5214:20–T5214:25
- 29 Exhibit 169 – Statement of Arnel, Annexure U (WIT.3000.002.0417)
- 30 Submissions of the State of Victoria (RESP.3000.004.0001) [19]; Building Amendment (Private Bushfire Shelter Construction) Interim Regulations 2009 s.7
- 31 Building Amendment (Private Bushfire Shelter Construction) Interim Regulations 2009 s.7
- 32 Submissions of the State of Victoria (RESP.3000.004.0001) [20]
- 33 Building Amendment (Private Bushfire Shelter Construction) Interim Regulations 2009 s.8
- 34 Submissions of the State of Victoria (RESP.3000.004.0001) [22]–[23]
- 35 Building Regulations 2006, regulation 115
- 36 Exhibit 500 – Response from the Building Commission dated 11 November 2009 (EXH.500.0003) at 0004
- 37 Arnel T5214:26–T5215:5

- 38 Exhibit 177 – Statement of Donaldson, Annexure 14 (WIT.6001.002.0419)
- 39 Arnel T5215:12–T5215:14
- 40 Exhibit 312 – Letter from Graham Huxley, Chairman, ABCB dated 24 September 2009 (EXH.312.0001) and attached media release (EXH.312.0002)
- 41 Submissions of the State of Victoria (RESP.3000.004.0001) [11]; Submissions of the Commonwealth (RESP.6001.001.0001) [6]; Submissions of AFAC (RESP.7500.003.0001) at 0001; Submissions of Standards Australia (RESP.7501.001.0001) [3]
- 42 Exhibit 85 – Statement of Gledhill, Attachment 8 (WIT.025.002.0084) at 0102; Chladil T5457:13; Exhibit 179 – Statement of Harding (WIT.7503.001.0001) [80]; Harding T5659:20–T5659:21; Exhibit 184 – Statement of Welch (WIT.7504.001.0001) [32]. Note here the concerns expressed by Mr Chladil and Mr Leonard that the testing standards AS1530.8.1 and AS1530.8.2 do not replicate bushfire conditions: Exhibit 174 – Statement of Chladil (WIT.7506.001.0001) [44]–[46]; Chladil T5442:29–T5443:1; T5449:21–T5451:15; T5489:23–T5490:26; Exhibit 175 – Leonard, Report to the 2009 Victorian Bushfires Royal Commission – Building Performance in Bushfires (TEN.066.001.0001) at 0052–0053, 0056–0058; Leonard T5546:24–T5548:19; T5562:27–T5563:8. See also Exhibit 172 – Statement of Eadie (WIT.7502.001.0001) [137]; Eadie T5380:10–T5381:27; Exhibit 169 – Statement of Arnel, Annexure Q (WIT.3000.002.0375) at 0390–0392
- 43 Exhibit 169 – Statement of Arnel, Annexure T (WIT.3000.002.0404) at 0412; Eadie T5394:8–T5394:9; Chladil T5457:14–T5457:22; Exhibit 179 – Statement of Harding (WIT.7503.001.0001) [80]; Harding T5659:16–T5659:20; Exhibit 184 – Statement of Welch (WIT.7504.001.0001) [32]
- 44 Exhibit 169 – Statement of Arnel, Annexure T (WIT.3000.002.0403) at 0412
- 45 Exhibit 169 – Statement of Arnel, Annexure T (WIT.3000.002.0404) at 0412; Leonard T5553:14–T5553:19; Exhibit 85 – Statement of Gledhill, Attachment 8 (WIT.025.002.0084) at 0102; Chladil T5458:1–T5458:8; Exhibit 179 – Statement of Harding (WIT.7503.001.0001) [80]; Harding T5659:28–T5660:7; McLennan T5702:1–T5702:15; Exhibit 184 – Statement of Welch (WIT.7504.001.0001) [32]; Orr T5888:4–T5888:16
- 46 Exhibit 169 – Statement of Arnel, Annexure T (WIT.3000.002.0404) at 0412; Leonard T5553:19–T5553:22; Exhibit 85 – Statement of Gledhill, Attachment 8 (WIT.025.002.0084) at 0102; Exhibit 184 – Statement of Welch (WIT.7504.001.0001) [32]
- 47 Exhibit 169 – Statement of Arnel, Annexure T (WIT.3000.002.0404) at 0412; Eadie T5394:9–T5394:11; Leonard T5553:14–T5553:22; Chladil T5458:1–T5458:8; Orr T5888:9–T5888:16
- 48 Exhibit 169 – Statement of Arnel, Annexure T (WIT.3000.002.0404) at 0412; Eadie T5394:16; Exhibit 85 – Statement of Gledhill, Attachment 8 (WIT.025.002.0084) at 0103; Chladil T5461:20–T5461:21; Exhibit 184 – Statement of Welch (WIT.7504.001.0001) [32]
- 49 Exhibit 169 – Statement of Arnel, Annexure T (WIT.3000.002.0404) at 0412; Eadie T5394:16–T5394:19; Leonard T5552:3–T5552:18
- 50 Exhibit 169 – Statement of Arnel, Annexure T (WIT.3000.002.0404) at 0412; Leonard T5552:4–T5552:7; Exhibit 179 – Statement of Harding (WIT.7503.001.0001) [80]
- 51 Eadie T5394:24–T5394:25; Leonard T5553:2–T5553:4; Exhibit 184 – Statement of Welch (WIT.7504.001.0001) [32]. This is a particular concern in relation to children who may enter the bunker when it is not in use as a bunker: see Berry T6115:26–T6116:24
- 52 Exhibit 169 – Statement of Arnel, Annexure T (WIT.3000.002.0404) at 0412; Chladil T5457:7–T5457:12; Exhibit 184 – Statement of Welch (WIT.7504.001.0001) [32]
- 53 Exhibit 501 – Response from the Commonwealth dated 11 November 2009 (EXH.501.0003) at 0004
- 54 Exhibit 501 – Response from the Commonwealth dated 11 November 2009 (EXH.501.0003) at 0003
- 55 Exhibit 312 – ABCB Media Release (EXH.312.0002)
- 56 Submissions of the Commonwealth (RESP.6001.001.0001) [10]

## AS 3959–2009 – CONSTRUCTION OF BUILDINGS IN BUSHFIRE PRONE AREAS

- 57 Exhibit 169 – Statement of Arnel, Annexure H (WIT.3000.002.0108) at 0117, 0217
- 58 Exhibit 169 – Statement of Arnel, Annexure H (WIT.3000.002.0108) at 0112
- 59 Submissions of Standards Australia (RESP.7501.001.0001) [6]–[7]; Tucker T5358:13–T5358:27
- 60 Eadie T5390:2–T5391:26
- 61 Exhibit 169 – Statement of Arnel, Annexure H (WIT.3000.002.0108) at 0112
- 62 Exhibit 169 – Statement of Arnel, Annexure H (WIT.3000.002.0108) at 0129, Table 2.3, Note 1
- 63 Exhibit 175 – Leonard, Report to the 2009 Victorian Bushfires Royal Commission – Building Performance in Bushfires (TEN.066.001.0001) at 0058; Leonard T5548:20–T5549:1; T5938:6–T5938:24
- 64 Chladil T5495:30–T5497:18
- 65 Exhibit 169 – Statement of Arnel (WIT.3000.002.0220) [203], Annexure Q (WIT.3000.002.0375) at 0382–0383; Arnel T5205:29–T5206:14
- 66 Exhibit 169 – Statement of Arnel, Annexure H (WIT.3000.002.0108) at 0120
- 67 Exhibit 169 – Statement of Arnel, Annexure H (WIT.3000.002.0108) at 0152, 0160, 0168, 0177, 0184
- 68 Exhibit 169 – Statement of Arnel, Annexure H (WIT.3000.002.0108) at 0155, 0163–0164, 0171–0172, 0179–0180
- 69 Exhibit 180 – Statement of McLennan (WIT.068.001.0001) [80]–[84]; McLennan T5697:5–T5697:29
- 70 Exhibit 175 – Leonard, Report to the 2009 Victorian Bushfires Royal Commission – Building Performance in Bushfires (TEN.066.001.0001) at 0051; Chladil T5448:24–T5449:9



## ENDNOTES

- 71 Exhibit 169 – Statement of Arnel, Annexure Q (WIT.3000.002.0375) at 0394
- 72 Exhibit 175 – Leonard, Report to the 2009 Victorian Bushfires Royal Commission – Building Performance in Bushfires (TEN.066.001.0001) at 0051, 0055; Leonard T5544:16–T5545:2; Chladil T5449:10–T5449:20; Harding T5654:8–T5654:21
- 73 Exhibit 175 – Leonard, Report to the 2009 Victorian Bushfires Royal Commission – Building Performance in Bushfires (TEN.066.001.0001) at 0051
- 74 Exhibit 180 – Statement of McLennan (WIT.068.001.0001) [76]–[77]; McLennan T5696:13–T5697:4
- 75 Submissions of the Commonwealth (RESP.6001.001.0001) [15]; Submissions of the State (RESP.3000.004.0001) [43]
- 76 Submissions of the Standards Australia (RESP.7501.001.0001) [22]–[23]
- 77 Exhibit 175 – Leonard, Report to the 2009 Victorian Bushfires Royal Commission – Building Performance in Bushfires (TEN.066.001.0001) at 0012–0015; Leonard T5507:25–T5508:22
- 78 Leonard T5534:15–T5534:22
- 79 Exhibit 175 – Leonard, Report to the 2009 Victorian Bushfires Royal Commission – Building Performance in Bushfires (TEN.066.001.0001) at 0020–0021 and 0023–0032; Exhibit 169 – Statement of Arnel, Annexure H (WIT.3000.002.0108) at 0142, Table 3.1; Eadie T5378:10–T5378:29
- 80 Exhibit 175 – Leonard, Report to the 2009 Victorian Bushfires Royal Commission – Building Performance in Bushfires (TEN.066.001.0001) at 0055–0056
- 81 Exhibit 169 – Statement of Arnel, Annexure H (WIT.3000.002.0108) at 0167–0168, 0176, 0183–0184
- 82 Refer to the sources cited by Mr Leonard at 8.3.3 of his report, Exhibit 175 – Leonard, Report to the 2009 Victorian Bushfires Royal Commission – Building Performance in Bushfires (TEN.066.001.0001) at 0055
- 83 Comments supporting CSIRO's negative vote – Exhibit 171 – Statement of Tucker, Exhibit JDT 88 (WIT.7501.005.0131) at 0131
- 84 Submissions of the Commonwealth (RESP.6001.001.0001) at 0003; Submissions of the State (RESP.3000.004.0001) [41]
- 85 Submissions of Standards Australia (RESP.7501.001.0001) at 0005–0007

### HB-36 – BUILDING IN BUSHFIRE PRONE AREAS

- 86 Eadie T5392:15–T5392:30
- 87 Eadie T5392:31–T5293:3; Exhibit 175 – Leonard, Report to the 2009 Victorian Bushfires Royal Commission – Building Performance in Bushfires (TEN.066.001.0001) at 0059
- 88 Submissions of Standards Australia (RESP.7501.001.0001) at 0009









**2009 Victorian Bushfires Royal Commission**

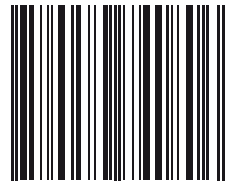
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