



***Technical Committee on NFPA 502 Road Tunnels, Bridges, and  
Other Limited Access Highways (ROA-AAA)***

**MEMORANDUM**

**TO:** Principal and Alternate Members of the Technical Committee on  
*NFPA 502 Road Tunnels, Bridges, and Other Limited Access  
Highways (ROA-AAA)*

**FROM:** **Sandra Stanek**, NFPA Staff Liaison

**DATE :** December 9, 2011

**SUBJECT:** **AGENDA – NFPA 502 ROP Meeting (Annual 2013 revision  
cycle) for the 2014 edition**

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Enclosed is the agenda for the Report on Proposals (ROP) meeting for *NFPA 502, Road Tunnels, Bridges, and Other Limited Access Highways Standard* which will be held at **on Sunday, January 15<sup>th</sup> (after 1 PM MST) through Thursday, January 19th, 2012 in Tempe, AZ.**

Please review the meeting notice, sent to your email address of record, for pertinent information concerning hotels, etc. Notify me immediately if you have any issues downloading the proposals from the committee website, etc. As your new staff liaison, I welcome any questions you may have & look forward to working with all of you.

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Cell: (339) 368-1186  
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For administrative questions, please contact Alma Woodberry at (617) 984-7949.



***Technical Committee on NFPA 502 Road Tunnels, Bridges, and  
Other Limited Access Highways (ROA-AAA)***

Report on Proposals Meeting (A2013) Agenda

January 15-19, 2012

**Embassy Suites Phoenix- Tempe**

**4400 S. Rural Road**

**Tempe, AZ**

***1:00 P.M. to 5:00 P.M. MST on Jan 15th***

***8:00 A.M. – 5:00 P.M. on January 16<sup>th</sup>-January 19<sup>th</sup>***

**Sunday, January 15, 2012:**

***Meeting room available after 1:00 PM***

1. Arrive at hotel & casually meet in the meeting room. Task Groups will have the ability to meet within the room for Task Group work.
2. Adjourn all @ 5:00 P.M. MST

**Monday, January 23, 2012:**

***8:00 A.M. -5:00 P.M.***

1. Call to Order – 8:00 A.M. MST
2. Introductions & Attendance
3. Review Agenda
4. NFPA Staff Liaison presentation & review of key dates within current cycle.
5. Chairman Comments
6. Approval of Previous Meeting Minutes (see Attachment #1)
7. Task Group work in individual meeting groups (A.M.)
8. Act on Public Proposals for NFPA 502 (P.M.) (see Attachment #2)
9. Adjourn Meeting @ 5:00 P.M. MST



***Technical Committee on NFPA 502 Road Tunnels, Bridges, and  
Other Limited Access Highways (ROA-AAA)***

**Tuesday, January 17, 2012:  
8:00 A.M. -5:00 P.M.**

1. Call to Order – 8:00 A.M. MST
2. Act on Public Proposals for NFPA 502 (see Attachment #2)
3. Adjourn Meeting @ 5:00 P.M. MST

**Wednesday, January 18, 2012:  
8:00 A.M. -5:00 P.M.**

1. Call to Order – 8:00 A.M. MST
2. Generate Committee Proposals based up on Task Group initiatives
3. Adjourn Meeting @ 5:00 P.M. MST

**Thursday, January 19, 2012:  
8:00 A.M. - ?**

1. Call to Order – 8:00 A.M. MST
2. Generate Task Group Proposal based on task group initiatives
3. Old Business
4. New Business
5. Future ROC Meeting discussion
6. Adjourn Meeting

**Please submit requests for additional agenda items to the chair at least seven days prior to the meeting.**

**Please notify the chair and staff liaison as soon as possible if you plan to introduce any committee proposals at the meeting.**



**Technical Committee on NFPA 502 Road Tunnels, Bridges, and  
Other Limited Access Highways (ROA-AAA)**

**Key Dates for the Annual 2013 Revision Cycle**  
(NFPA 502 2014 edition)

Proposal Closing Date	November 25, 2011
<b>Final Date for ROP Meeting</b>	<b>February 24, 2012</b>
Final Date for Mailing TC Ballots	March 16, 2012
<b>Ballots Returned By</b>	<b>April 20, 2012</b>
ROP Published & Posted	June 22, 2012
Comment Closing Date	August 31, 2012
<b>Final Date for ROC Meeting</b>	<b>November 2, 2012</b>
Final date for mailing TC ballots	November 16, 2012
<b>Ballots Returned By</b>	<b>November 30, 2012</b>
ROC Published & Posted	February 22, 2013
Closing Date for Notice of Intent to Make a Motion (NITMAM)	April 5, 2013
<i>Issuance of Consent Document (No NITMAMs)</i>	<i>May 28, 2013</i>
NFPA Annual Meeting	June 2013
<i>Issuance of Document with NITMAM</i>	<i>August 1, 2013</i>

Technical Committee deadlines are in **bold**.



## ***Technical Committee on NFPA 502 Road Tunnels, Bridges, and Other Limited Access Highways (ROA-AAA)***

### **Meeting Preparation**

Committee members are strongly encouraged to review the published proposals prior to the meeting and to be prepared to act on each item.

Handout materials should be submitted to the chair at least seven days prior to the meeting.

Only one posting of the proposals will be made; it will be arranged in section/order and will be pre-numbered. This will be posted to the NFPA Document information pages are located at [www.nfpa.org/502](http://www.nfpa.org/502). If you have trouble accessing the website please contact Alma Woodberry at [awoodberry@nfpa.org](mailto:awoodberry@nfpa.org).

#### **Materials to have at meeting:**

- Last edition of the standard
- Meeting agenda
- Public proposals & associated attachments

### **Regulations and Guiding Documents**

All committee members are expected to behave in accordance with the Guide for the Conduct of Participants in the NFPA Standards Directory (on-line).

All actions during and following the committee meetings will be governed in accordance with the NFPA Regulations Governing Committee Projects. Failure to comply with these regulations could result in challenges to the standards-making process. A successful challenge on procedural grounds could prevent or delay publication of the document.

The style of the document must comply with the Manual of Style for NFPA Technical Committee Documents.



## ***Technical Committee on NFPA 502 Road Tunnels, Bridges, and Other Limited Access Highways (ROA-AAA)***

### **General Procedures for Meetings**

- Use of tape recorders or other means capable of producing verbatim transcriptions of any NFPA Committee Meeting is not permitted.
- Attendance at all NFPA Committee Meetings is open. All guests must sign in and identify their affiliation.
- Participation in NFPA Committee Meetings is generally limited to committee members and NFPA staff. Participation by guests is limited to individuals, who have received prior approval from the chair to address the committee on a particular item, or who wish to speak regarding public proposals or comments that they submitted.
- The chairman reserves the right to limit the amount of time available for any presentation.
- No interviews will be allowed in the meeting room at any time, including breaks.
- All attendees are reminded that formal votes of committee members will be secured by letter ballot. Voting at this meeting is used to establish a sense of agreement, but only the results of the formal letter ballot will determine the official action of the committee.
- Note to Special Experts: Particular attention is called to Section 3.3(e) of the NFPA Guide for the Conduct of Participants in the NFPA Codes and Standards Development Process in the NFPA Directory. This section requires committee members to declare any interest they may represent, other than their official designation as shown on the committee roster. This typically occurs when a special expert is retained by and represents another interest category on a particular subject. If such a situation exists on a specific issue or issues, the committee member shall declare those interests to the committee and refrain from voting on any action relating to those issues.
- Smoking is not permitted at NFPA Committee Meetings.



***Technical Committee on NFPA 502 Road Tunnels, Bridges, and  
Other Limited Access Highways (ROA-AAA)***

**Attachment #1:**

***Previous Meeting Minutes***

**NFPA 502**  
**Technical Committee on Road Tunnel and Highway Fire Protection**  
**A2013 Pre-ROP Web/Teleconference Meeting Minutes**  
**October 21, 2011**

**1. Call to Order**

Web/Teleconference was called to order by Bill Connell at 9:20 AM EST on Friday October 21, 2011.

**2. Introductions & Roll Call**

Sandra Stanek was introduced as the new staff liaison for the NFPA 502 Committee.

The following members, alternates, and guests were in attendance:

<b>Name</b>	<b>Representing</b>
<b><i>Principal Members</i></b>	
Sandra Stanek	NFPA Liaison
Bill Connell, Chair	PB Americas, Inc.
Ian Barry	IEB Consulting
Arthur Bendelius	A&G Consultants, Inc
Alan Brinson	International Fire Sprinkler Association
John Dalton	WR Grace
Alexandre Debs	Ministere Des Transports Du Quebec
Arnold Dix	Counsel at Law/Adj. Prof. Engineering
Mike Fitzpatrick	Massachusetts Department of Transportation
Jason Huczek	Southwest Research Institute
Haukur Ingason	SP Technical Research Institute of Sweden
Ahmed Kashef	National Research Council of Canada
Joseph Kroboth, III	Washington County Division of Public Works
Igor Maevski	Jacobs Engineering
Tony Marino	Port Authority NY/NJ
Maurice Pilette	Mechanical Designs Ltd.
David Plotkin	AECOM
Norman Rhodes	Hatch Mott MacDonald
Rene van den Bosch	Promat
<b><i>Alternates</i></b>	
Daniel Dirgins	PB Americas, Inc
Gary English	Seattle Fire Department
Russell Fleming	International Fire Sprinkler Association
Stefan Kratzmeir	FogTec Fire Protection

Nader Shahcheraghi                      AECOM

***Guests Present***

Chiam Boon                                      Land Transport Authority - Singapore  
Jim Conrad                                      RSCC Wire and Cable

***Members & Alternates not Present***

David LeBlanc                                  Tyco Fire & Building Products  
John Nelson                                      Seattle Fire Department  
Jesus Rohena                                    Federal Highway Administration  
Dirk Sprakel                                    FogTech Fire Protection  
Melvin Thong                                    Land Transport Authority - Singapore  
Mark Janssens (alt)                            Southwest Research Institute  
Leong Kwok Weng (alt)                        Land Transport Authority - Singapore

***Note: Members not in attendance should refer to the task group assignments attached to these meeting minutes for their expected task group participation.***

**3. Committee Member Status & Update of Membership Roster**

***Resignations***

Kai Kang    Jacobs Engineering  
Roger Lichtenwald                              American Warming and Ventilating  
Colin Macedo                                    HNTB  
Darham Pal                                        Port Authority NY/NJ

***New Principal Members***

John Dalton                                      WR Grace  
Alexandre Debs                                   Minstere Des Transports Du Quebec  
Mike Fitzpatrick                                Massachusetts Department of Transportation  
Tony Marino                                        Port Authority NY/NJ  
David Plotkin                                      AECOM  
Norman Rhodes                                   Hatch Mott MacDonald

***New Alternates***

Nader Shahcheraghi                            AECOM  
(alt to D. Plotkin)

***SEE CURRENT MEMBER LIST ATTACHED***

#### 4. Key Dates for NFPA of 502 A2013 Revision Cycle

Sandra Stanek reviewed the timeline and key dates associated with the A2013 revision cycle which results in the issuance of the 2014 Edition of the Standard:

Proposal Closing	November 25, 2011
ROP Meeting	January 16-19, 2012
ROP Published	June 22, 2012
Comments Closing	August 31, 2012
Final Date for ROC Meeting	November 2, 2012
ROC Published	February 22, 2013
Intent to make motion closing (NITMAN)	April 5, 2013
NFPA Annual Meeting (tbd)	June 2013

***See A2013 Revision Cycle Schedule Attached***

#### 5. Goals of Meeting

**The chair identified the following primary goals for this meeting:**

- Prepare and coordinate committee activities to support the new revision cycle.
- Establish Task Groups to ready committee proposals for presentation at the ROP meeting.
- Reinforce the need for members and Task Groups to be well prepared in advance of the ROP Meeting in January 2012 to ensure an efficient a process as possible.

#### 6. Approval of Meeting Minutes from September 28-30, 2009 ROC Meeting Minutes from the ROC Meeting held in San Diego, CA.

Meeting minutes were accepted and approved without comment.

#### 7. Industry Updates

**Publications:**

- **Design Fires in Road Tunnels National Cooperative Highway Research Program, NCHRP Synthesis 415**

The Chair acknowledged committee member Igor Maevski for his authorship of this document which was published earlier this year. Committee members Gary English and Jesus Rohena served on the expert review panel. .

- **ITA Committee on Safety of Underground Facilities (COSUF) Updated survey of existing regulations and recognized recommendations (operation and safety of road tunnels) August 2011.**

A recently updated compendium of existing regulations and recommendations regarding road tunnel operation and safety is available at the following web link:

<http://www.ita-aites.org/?id=699>

#### **Conferences/Symposiums:**

- **ISTSS 2012, 5<sup>th</sup> International Symposium on Tunnel Safety and Security, March 14-16, 2012, New York City**  
<http://www.istss.se/en/symposium/istss2012/Registration/Sidor/default.aspx>  
[X](#)

- **2nd International Conference on Fires in Vehicles, September 27-28, 2012, Chicago, IL**

More information is available at the following web link:

<http://www.firesinvehicles.com/en/Sidor/default.aspx>

- **Transportation Research Board 91<sup>st</sup> Annual Meeting, January 22-26, 2012, Washington DC**

Igor Maevski to present Design Fires in Road Tunnels National Cooperative Highway Research Program, NCHRP Synthesis 415 to the AASHTO T-20 committee.

- **ASHRAE Winter Conference, January 21-25, 2012, Chicago IL**

Igor Maevski to present Design Fires in Road Tunnels National Cooperative Highway Research Program, NCHRP Synthesis 415.

#### **Other:**

- **National Research Council Canada, Protection of Transportation Infrastructure from Fire Damage**

The NRC Institute for Research in Construction (NRC-IRC) is currently developing systems to assess the condition, performance and remaining service life of certain critical infrastructure, and to protect them from hazards such as earthquakes, wind, floods, and explosions. More information is available at the following web link:

<http://www.nrc-cnrc.gc.ca/eng/ci/v16n3/15.html>

- **US Department of Transportation - - Past NFPA 502 staff liaison**

Jason Gamache is now working at the USDOT's Volpe Center (Cambridge, MA), which facilitates research projects for the improvement of transportation infrastructure. Jason has offered their assistance to the

committee for any potential research projects. His email address is:  
[jason.gamache@dot.gov](mailto:jason.gamache@dot.gov)

## **8. Proposed Issues Requiring Address for A2013**

The committee was asked to identify topics and areas for consideration in the A2013 revision cycle. Bill Connell indicated that the areas selected should be achievable within the relatively short timeframe available. Some specific items for consideration that were briefly identified are listed below:

- How to address exiting tunnels, tunnel length extensions, overbuilds, retroactivity, etc (T. Marino)
- Various “official” proposals submitted to NFPA (A. Brinson)
- Reference standards regarding testing of materials for protection of structure (J. Dalton)
- General document editorial clean-up. (B. Connell)
- Table 7.2 edits (B. Connell)
- Review full applicability of NFPA 101 to tunnel Emergency Egress requirements (B. Connell)
- Review full applicability of NFPA 13 to tunnel FFFS requirements (B. Connell)
- Harmonizing NFPA 502 with NFPA 130 where applicable (D. Plotkin)
- Further clarification of Scope and areas of inapplicability in Paragraph 1.1.3 (D. Plotkin)
- Clarification regarding depressed highways, air rights structures, underground bus station approach tunnels (D. Plotkin)

It will be the responsibility of the appropriate Task Group to address these issues. Public proposals will also be categorized and assigned to the appropriate Task Group for recommended action at the ROP.

## **9. Establishment of Task Groups**

Task Groups from the previous cycle were reviewed to determine the need or desire to maintain their category of focus for this current cycle. It was decided that all twelve (12) previous Task Group categories should remain in place.

Each Task Group category was discussed and committee members were assigned based on their areas of interest/expertise. Task Group leaders were identified.

Task Groups shall establish their own individual agendas with the goal being to prepare Committee Proposals for presentation at the ROP Meeting. In addition, public proposals received by the November 25<sup>th</sup> closing date will be categorized and distributed to the appropriate Task Groups for recommended action at the

ROP Meeting. Bill Connell reiterated that the Task Group agendas should be achievable within the short period of time available between now and the ROP meeting. Members were also reminded that Committee Proposals can still be refined at the ROC Meeting.

***A list of the Task Groups and individual committee member assignments are attached.***

**10. ROP Meeting January 15-19, 2012 in Tempe, AZ.**

The Chair presented the following as a draft agenda for the ROP Meeting noting that meeting space at the hotel will be available for the Task groups to use on the 15<sup>th</sup> and 16<sup>th</sup>:

- Day One – Members arrive at meeting location and Task Groups meet to refine committee proposals.
- Day Two (Morning) – Task Groups continue.
- Day Two (Afternoon) – Convene full Committee to begin to address public proposals.
- Day Three – Full Committee completes addressing public proposals.
- Day Four - Full Committee to consider Task Group (committee) proposals.
- Day Five (Morning) - Full Committee to complete Task Group (committee) proposals. Adjourn.

**11. Confirmation of Assignments**

A list of the Task Group categories and members assignments will be drafted and distributed immediately for all members present and absent to confirm. (This was done and final assignments are attached).

**12. Meeting Adjourned @ 12:10 noon EST on October 21, 2011**



***Technical Committee on NFPA 502 Road Tunnels, Bridges, and  
Other Limited Access Highways (ROA-AAA)***

**Attachment #2:**  
***Report on Proposals***

# Chair Report

12/9/2011

Log	Proposal No.	Code Reference	Log	Proposal No.	Code Reference
___ CP1	502-	Entire Document	___ 60	502-	7.10
___ 5	502-	2.2	___ 72	502-	7.10
___ 47	502-	2.3.1 and M.1.2.5	___ 83	502-	7.12.4
___ 2	502-	2.3.6	___ 40	502-	7.12.4 and A.7.12.4
___ 34	502-	2.3.6	___ 88	502-	8.2
___ 79	502-	3.3.5(a) and A.3.3.5(a) (New)	___ 91	502-	8.4.2
___ 49	502-	3.3.16 Emergency	___ 61	502-	8.9
___ 37	502-	3.3.16 Emergency	___ 62	502-	Chapter 9
___ 50	502-	3.3.21 Facility	___ 30	502-	Chapter 9 and 10
___ 51	502-	3.3.23 Fire Department	___ 76	502-	9.1.1
___ 52	502-	3.3.24 Fire Emergency	___ 29	502-	9.2.2.3 (New)
___ 53	502-	3.3.25 Fire Growth Rate	___ 63	502-	9.3.2
___ 54	502-	3.3.30.3 Length of Bridge or	___ 75	502-	9.3.4 (New)
___ 55	502-	3.3.34 Incident Commander,	___ 64	502-	9.6
___ 65	502-	3.3.36.x Motor Vehicle (New)	___ 78	502-	10.4.2
___ 38	502-	3.3.37 Noncombustible	___ 73	502-	11.1.1
___ 48	502-	3.3.37 Noncombustible	___ 81	502-	11.1.4 (New)
___ 82	502-	3.3.37 Noncombustible	___ 84	502-	11.4.3 (New)
___ 67	502-	3.3.43 Quantified Risk	___ 36	502-	Chapter 12
___ 56	502-	3.3.45 Rijkswaterstaat (RWS)	___ 41	502-	12.2.1.3(3)
___ 57	502-	3.3.48 Rural	___ 42	502-	12.2.1.3(3) and (4)
___ 77	502-	4.2.1	___ 43	502-	12.3.1
___ 87	502-	4.3.1(20) (New)	___ 44	502-	12.3.2
___ 6	502-	4.7.1	___ 45	502-	12.3.3 and A.12.3.3.(1) (New)
___ 58	502-	6.6	___ 46	502-	12.3.3 and A.12.3.3(1) (New)
___ 7	502-	6.6.1	___ 66	502-	Table A.1.6.1
___ 71	502-	6.6.1	___ 4	502-	A.3.3.37
___ 8	502-	6.8.1	___ 10	502-	A.7.1.2
___ 85	502-	7.x, and 7.xx (New)	___ 16	502-	A.7.3.2
___ 9	502-	7.1.2	___ 31	502-	A.9.2.2.3
___ 11	502-	7.2	___ 32	502-	A.9.3.1 and A.9.5.2
___ 12	502-	7.2	___ 18	502-	Table A.11.5.1
___ 13	502-	Table 7.2	___ 86	502-	Table A.11.5.1
___ 14	502-	Table 7.2	___ 89	502-	D.1
___ 68	502-	Table 7.2	___ 19	502-	E.3
___ 1	502-	7.2, Table 7.2, and 7.3.1	___ 33	502-	E.3
___ 69	502-	7.3	___ 22	502-	E.3.3
___ 90	502-	7.3 and 7.3.5	___ 20	502-	E.4.1
___ 15	502-	7.3.2	___ 23	502-	E.4.1
___ 39	502-	7.3.4(2)	___ 21	502-	E.4.2
___ 70	502-	7.4.1	___ 24	502-	E.4.2
___ 80	502-	7.4.1.3 and 7.4.1.3.6 (New)	___ 25	502-	E.5.1
___ 59	502-	7.8	___ 26	502-	E.5.2
___ 17	502-	7.10	___ 74	502-	E.5.2

# Chair Report

12/9/2011

<u>Log</u>	<u>Proposal No.</u>	<u>Code Reference</u>	<u>Log</u>	<u>Proposal No.</u>	<u>Code Reference</u>
27	502-	E.5.3			
28	502-	E.6			
3	502-	M.1.2.15			
35	502-	M.1.2.15			

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502- Log #CP1  
(Entire Document)

Final Action:

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Submitter: Technical Committee on Road Tunnel and Highway Fire Protection,

Recommendation: Review entire document to: 1) Update any extracted material by preparing separate proposals to do so, and 2) review and update references to other organizations documents, by preparing proposal(s) as required.

Substantiation: To conform to the NFPA Regulations Governing Committee Projects.

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502- Log #5  
(2.2)

Final Action:

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Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Add text to read as follows:

NFPA 3

Substantiation: This standard is about commissioning. It was not available for the 2011 edition of NFPA 502.

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502- Log #47  
(2.3.1 and M.1.2.5)

Final Action:

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Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise text to read as follows:

2.3.1 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, ~~2011~~ 2009.

M.1.2.5 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, ~~2011~~ 2009.

~~ASTM E 580, *Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint*, 2006.~~

ASTM E580/E580M Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions. 2011 a e<sup>1</sup>

ASTM E 2652, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C with a Cone-Shaped Airflow Stabilizer*, 2009a.

Substantiation: Standards update.

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502- Log #2  
(2.3.6)

Final Action:

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Submitter: John F. Bender, Underwriters Laboratories Inc.

Recommendation: Revise text as follows:

2.3.6 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 1685, *Standard Vertical Cable-Tray Fire-Propagation and Smoke Release Test for Electrical and Optical Fiber Cables*, 2007, Revised ~~December 2007~~ 2010.

ANSI/UL Subject 1724, *Outline of Investigation for Fire Tests for Electrical Circuit Protective Systems*, 2006.

ANSI/UL 2196, *Standard for Safety for Tests for Fire Resistive Cables*, 2001, Revised December 2006.

Substantiation: Reason: Update title of ANSI/UL 1685 as indicated.

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502- Log #34  
(2.3.6)

Final Action:

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Submitter: John F. Bender, Underwriters Laboratories Inc.

Recommendation: Revise text as follows:

2.3.6 UL Publications. Underwriters Laboratories Inc.,

333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 1685, Standard Vertical Cable- Tray Fire- Propagation and Smoke Release Test for Electrical and Optical Fiber Cables, 2007, Revised

~~December 2007~~ 2010.

ANSI/UL Subject 1724, Outline of Investigation for Fire Tests for Electrical Circuit Protective Systems, 2006.

ANSI/UL 2196, Standard for Safety for Tests for Fire Resistive Cables, 2001, Revised December 2006.

Substantiation: Reason: Update title of ANSI/UL 1685 as indicated.

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502- Log #79

(3.3.5(a) and A.3.3.5(a) (New) )

Final Action:

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Submitter: Gary L. English, Seattle Fire Department

Recommendation: Add new text to read as follows:

3.3.5(a) Basis of Design (BOD). A document that shows the concepts and decisions used to meet the owner's project requirements and applicable standards, laws, and regulations. [3, 2012]

A.3.3.5(a) Basis of Design (BOD). The BOD is normally used to assist the commissioning authority and the AHJ in the plan review, inspection, and acceptance process.

Substantiation: Term, Basis of Design, is used in the text in 4.7.1 without definition or explanation of use. Adding definition and annex language from NFPA 3, *Recommended Practice for Commissioning and Integrated Testing of Fire Protection and Life Safety Systems*, 2012 Edition, provides clarity to 502 standard.

This is not original material; its reference/source is as follows:

NFPA 3, *Recommended Practice for Commissioning and Integrated Testing of Fire Protection and Life Safety Systems*, 2012 Edition.

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502- Log #49

(3.3.16 Emergency Communications)

Final Action:

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Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Revise definition of emergency communication to read:

**3.3.16 Emergency Communications.** For road tunnels, bridges, and limited access highways, radio, telephone, and messaging throughout the facility. ~~Emergency communications, where required, shall be by "the installation of outdoor-type telephone boxes, coded alarm telegraph stations, radio transmitters, or other approved devices."~~

Substantiation: The specific system technical requirement does not belong in 3.3 General Definitions. These requirements are already contained in section 4.5 on page 502-9.

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502- Log #37 Final Action:  
(3.3.16 Emergency Communications and A.3.3.16 (New) )

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Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise definition to read as follows:

**3.3.16\* Emergency Communications.** For road tunnels, bridges, and limited access highways, radio, telephone, and messaging throughout the facility. ~~Emergency communications, where required, shall be by the installation of outdoor-type telephone boxes, coded alarm telegraph stations, radio transmitters, or other approved devices.~~

A.3.3.16 Emergency communications, where required, should be by the installation of outdoor-type telephone boxes, coded alarm telegraph stations, radio transmitters, or other approved devices (see 4.5).

Substantiation: The NFPA Manual of Style requires definitions to be in single sentences. The added sentences should not be part of the definition (and in this case they are simply added explanations) but should be in the body of the document or in an annex note, as recommended in this proposal. In fact, section 4.5 has virtually the same language.

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502- Log #50 Final Action:  
(3.3.21 Facility)

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Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Revise definition of facility to read:

**3.3.21 Facility.** A limited access highway, road tunnel, air-right structure, bridge, or elevated highway.

Substantiation: Air-right structure is a defined facility covered by this standard (3.5.49.1 \*) and should be included in this definition of facility contained in 3.3.21 Facility .

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502- Log #51 Final Action:  
(3.3.23 Fire Department Connection)

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Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Revise definition of fire department connection to read:

**3.3.23 Fire Department Connection.** A connection through which the fire department can pump ~~supplemental~~ water into the fixed water-based fire suppression sprinkler system, standpipe system, or other systems furnishing water for fire suppression and extinguishment to supplement existing water supplies.

Substantiation: The use of the word "supplemental" relating to the pumped water is redundant. The term "sprinkler" is no longer used in this standard. The proper term is "fixed water-based fire suppression" as defined in 3.3 General Definitions in 3.3.29\*.

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502- Log #52 Final Action:  
(3.3.24 Fire Emergency)

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Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Revise definition of fire emergency to read:

**3.3.24 Fire Emergency.** The existence of, or threat of fire or the development of smoke or fumes, or any combination thereof, that demands immediate action to mitigate ~~correct or alleviate~~ the condition or situation.

Substantiation: I think mitigate is a better word for this application than "correct" or "alleviate".

502- Log #53  
(3.3.25 Fire Growth Rate)

Final Action:

Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Revise definition of fire growth rate to read:

3.3.25 Fire Growth Rate. Rate of change of the fire's heat release expressed as MW/min.

Substantiation: The units for the fire growth rate should be included in this definition.

502- Log #54  
(3.3.30.3 Length of Bridge or Elevated Highway)

Final Action:

Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Delete the definition of Length of Bridge or Elevated Highway (definition to be relocated):

~~3.3.30.3\* Length of Bridge or Elevated Highway. The linear distance measured along the centerline of a bridge or elevated highway structure from abutment to abutment.~~

Substantiation: This definition of "*Length of Bridge or Elevated Highway*" was placed in the incorrect location under 3.3.30 Highway .

502- Log #55  
(3.3.34 Incident Commander, 3.3.34 Length of Bridge or Elevated Highway, and 3.3.35 Length of Tunnel)

Final Action:

Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Insert the definition of length of bridge and elevated highway as shown:

3.3.33 Incident Commander. The individual in overall command of an emergency incident. [1561,2008]

3.3.34\* Length of Bridge or Elevated Highway. The linear distance measured along the centerline of a bridge or elevated highway structure from abutment to abutment.

~~3.3.35~~ ~~3.3.34~~ Length of Tunnel. The length from face of portal to face of portal that is measured using the centerline alignment along the tunnel roadway.

Substantiation: This definition of "Length of Bridge or Elevated Highway" should be placed between the definitions for "Incident Commander" and "Length of Tunnel".

502- Log #65  
(3.3.36.x Motor Vehicle (New) )

Final Action:

Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Insert a new definition in 3.3 General Definitions :

3.3.36a Motor Vehicle. pertaining to this Standard, any self-propelled vehicle, automobile, truck, tractor, semitrailer, or truck-trailer combination used for the transportation of persons or things over public highways.

Substantiation: A Motor Vehicle is defined in the NFPA Glossary of Terms as "any self-propelled vehicle, truck, tractor, semitrailer, or truck-trailer combination used for the transportation of freight over public highways". The term "Motor Vehicle" appears in the NFPA 502 Standard all considering the motor vehicle to include the transportation of people or motorists.

502- Log #38

Final Action:

(3.3.37 Noncombustible Material, 4.8, A.3.3.37, and A.4.8)

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Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise text to read as follows:

~~3.3.37\* Noncombustible Material. (see 4.8) A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to a fire or heat. Materials that are reported as passing ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, or other equivalent standards shall be considered noncombustible materials.~~

~~4.8\* Noncombustible Materials. A material that complies with any of the following shall be considered a noncombustible material:~~

~~(1)\* A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors, when subjected to fire or heat~~

~~(2) A material that is reported as passing ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C*~~

~~(3) A material that is reported as complying with the pass/ fail criteria of ASTM E 136 when tested in accordance with the test method and procedure in ASTM E 2652, *Standard Test Method for Behavior of Materials in a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750 Degrees C*. [5000:7.1.4.1.1]~~

~~A.4.8 The provisions of 4.8 do not require inherently noncombustible materials to be tested in order to be classified as noncombustible materials. [5000:A.7.1.4.1]~~

~~A.4.8 (1) Examples of such materials include steel, concrete, masonry and glass. [5000:A.7.1.4.1.1(1)]~~

A.3.3.37 Noncombustible Material. Standards other than ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, exist that are used to assess non-combustibility of materials. They include: ASTM E 2652, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C with a Cone-Shaped Airflow Stabilizer*; ISO 1182, *Reaction to Fire Tests for Building and Transport Products — Non-Combustibility Test*; and BS 476-4, *Fire Tests on Building Materials and Structures, Non-Combustibility Test for Materials*.

Add references to ASTM E 2652, Standard Test Method for Behavior of Materials in a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750 Degrees C (2009a) into Chapter 2 on referenced standards.

Substantiation: NFPA 101 and 5000 have been revised so that the definitions of noncombustible material (and of limited combustible material, which is not used in NFPA 502) have been eliminated and replaced by sections in the code or standard that will now be the place that contains requirements for the use of the concepts. Definitions are not enforceable in NFPA documents and should not contain requirements.

The choice of the sections in chapter 4 where references to noncombustible material are placed was based on choosing a general section.

502- Log #48

Final Action:

(3.3.37 Noncombustible Material and 4.8, A.3.3.37, and A.4.8.1)

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Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise text to read as follows:

~~3.3.37\* Noncombustible Material. (see 4.8) A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to a fire or heat. Materials that are reported as passing ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, or other equivalent standards shall be considered noncombustible materials.~~

4.8 Noncombustible Material.

4.8.1\* A material that complies with any of the following shall be considered a noncombustible material:

(1)\* A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors, when subjected to fire or heat

(2) A material that is reported as passing ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C*

(3) A material that is reported as complying with the pass/ fail criteria of ASTM E 136 when tested in accordance with the test method and procedure in ASTM E 2652, *Standard Test Method for Behavior of Materials in a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750 Degrees C*. [5000:7.1.4.1.1]

4.8.2 Where the term limited-combustible is used in this Code, it shall also include the term noncombustible. [5000:7.1.4.1.2]

A.4.8.1 The provisions of 4.8.1.1 do not require inherently noncombustible materials to be tested in order to be classified as noncombustible materials. [5000:A.7.1.4.1]

A.4.8.1 (1) Examples of such materials include steel, concrete, masonry and glass. [5000:A.7.1.4.1.1(1)]

A.3.3.37 Noncombustible Material. Standards other than ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, exist that are used to assess noncombustibility of materials. They include: ASTM E 2652, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C with a Cone-Shaped Airflow Stabilizer*; ISO 1182, *Reaction to Fire Tests for Building and Transport Products — Non-Combustibility Test*; and BS 476-4, *Fire Tests on Building Materials and Structures, Non-Combustibility Test for Materials*.

Also add a reference to ASTM E 2652, *Standard Test Method for Behavior of Materials in a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750 Degrees C (2009a)* into Chapter 2 on referenced standards.

Substantiation: NFPA 101 and 5000 have been revised so that the definitions of noncombustible material and of limited combustible material have been eliminated and replaced by sections in the code or standard that will now be the place that contains requirements for the use of the concepts. Definitions are not enforceable in NFPA documents and should not contain requirements.

The choice of the sections in chapter 4 where references to limited combustible material and noncombustible material are placed was based on where these terms are used.

This does not require compliance with NFPA 5000.

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502- Log #82

Final Action:

(3.3.37 Noncombustible Material and A.3.3.37)

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Submitter: Gary L. English, Seattle Fire Department

Recommendation: Revise text to read as follows:

**3.3.37\* Noncombustible Material.** A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to a fire or heat. Materials that are reported as passing ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, or other equivalent standards shall be considered noncombustible materials. Note: Tunnel fires may exceed 1200 C and test methods should reflect the potential temperature.

**A.3.3.37 Noncombustible Material.** Standards other than ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, exist that are used to assess non-combustibility of materials. They include: ASTM E 2652, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C with a Cone-Shaped Airflow Stabilizer*; ISO 1182, *Reaction to Fire Tests for Building and Transport Products — Non-Combustibility Test*; and BS 476-4, *Fire Tests on Building Materials and Structures, Non-Combustibility Test for Materials*. A standard test that represents the potential temperatures found in the tunnel should be used.

Substantiation: Most tests do not recognize the potential temperatures found in tunnels. Changing the definition is necessary to ensure designers/ engineers recognize the potential.

Annex language change allows the currently listed tests for lower temperatures, but calls for use of a standard test that reflects the temperatures that might be found.

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502- Log #67

Final Action:

(3.3.43 Quantified Risk Assessment (QRA) (New) )

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Submitter: Ian E. Barry, IEB Consulting Ltd.

Recommendation: Add a definition for Quantified Risk Assessment (QRA) - suggest inserting this in 3.3.43 using the following wording:

**3.3.43 Quantified Risk Assessment (QRA)** – is a Risk Evaluation used to identify specific operational risks and to select appropriate fire and life safety mitigation measures for any specific tunnel or facility.

The current definition at 3.3.43 (Queue) moves to 3.3.44 and the remainder of the definitions follow chronologically.

Substantiation: The Technical Committee has assigned Task Group 12 to address QRA's and is committed to address this QRA issue during the current revision cycle.

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502- Log #56

Final Action:

(3.3.45 Rijkswaterstaat (RWS))

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Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Revise definition 3.3.45 as shown below:

**3.3.45 ~~Rijkswaterstaat (RWS)~~ RWS (Rijkswaterstaat) Time-Temperature Curve.** The fire test and time temperature curve described in report, Efectis-R0695, 2008.

Substantiation: Rijkswaterstaat (RWS) is an agency in the Netherlands. The described time-temperature curve should be called the RWS Time-Temperature Curve.

502- Log #57  
(3.3.48 Rural)

Final Action:

Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Insert the definition of rural as shown below into 3.2 General Definitions and renumber:

3.3.48 Rural Those areas that are not unsettled wilderness or uninhabitable territory but are sparsely populated with densities below 500 persons per square mile. [1142,2007]

Substantiation: The term "rural" is used in 6.2.3 to indicate where this Standard does not apply in the case of bridges and elevated highways therefore a definition of rural is necessary.

502- Log #77  
(4.2.1)

Final Action:

Submitter: Gary L. English, Seattle Fire Department

Recommendation: Add new text to read as follows:

4.2.1 Standpipe Installations in Tunnels Under Construction.

\*4.2.1.1 A standpipe system shall be installed in tunnels under construction in accordance with NEPA 241.

4.2.1.1.1 A standpipe system shall be installed before the enclosed tunnel has exceeded a length of 61 m (200 ft) beyond any access shaft or portal and shall be extended as work progresses to within 61 m (200 ft) of the most remote portion of the enclosed tunnel.

4.2.1.1.2 Standpipes shall be sized for approved water flow and pressure at the outlet, based upon the maximum predicted fire load.

4.2.1.1.3 Reducers or adapters shall be provided and attached for connection of the contractor's hose.

4.2.1.1.4 Reducers or adapters shall be readily removable through the use of a fire fighter's hose spanner wrench.

4.2.1.1.5 Outlets shall be clearly identified with contrasting markings and with signs to readily identify the location in the tunnel and which standpipe is being used.

4.2.1.1.6 Outlets shall be readily accessible for fire department use.

4.2.1.1.7 Risers and outlets shall be protected from accidental damage.

A.4.2.1.1 Tunnel Boring Machine cooling water may be used for the standpipe line provided this line is always charged and functional, and the pressures needed for standpipe outlets do not exceed pressure limits of the TBM. This may be achievable by using the return cooling line from the TBM with a double back flow preventer to prevent overpressuring the TBM.

Substantiation: This was approved in the 2011 cycle, but left out of the document. Slight changes have been made to the text for clarity, and annex language added to clarify a potential use that saves the expense of installing a dedicated standpipe line.

502- Log #87  
(4.3.1(20) (New) )

Final Action:

Submitter: Gary L. English, Seattle Fire Department

Recommendation: Add new text to read as follows:

(20) Impacts to facility from external operations and/ or incidents

Substantiation: Adding new (20) clarifies need to include external impacts as a possible factor for analysis.

Operations of nearby facilities can produce smoke that is drawn into the facility ventilation. Likewise fires near the facility can produce smoke that impacts the safe operations. Traffic outside the tunnel can cause backups into the tunnel or onto a bridge that impacts operations. E.g. backing up traffic from an emergency onto a bridge could disrupt operations.

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502- Log #6  
(4.7.1)

Final Action:

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Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Revise text to read as follows:

The agency shall require the development of a commissioning plan to facilitate the verification of the operational readiness of all installed fire protection, life safety, and emergency systems required by this standard, other applicable NFPA standards, in particular NFPA 3, and as required within the basis of design (BOD) for construction.

Substantiation: NFPA 3 is about commissioning. It was not available for the 2011 edition of NFPA 502.

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502- Log #58  
(6.6)

Final Action:

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Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Revise the heading for 6.6 as shown below:

6.6 Standpipe, ~~Fire Hydrants,~~ and Water Supply.

Substantiation: Fire Hydrants are not mentioned anywhere in Chapter 6 therefore delete the phrase "Fire Hydrants" from the 6.6 heading.

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502- Log #7  
(6.6.1)

Final Action:

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Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Revise text to read as follows:

Where the length of a bridge or elevated highway exceeds 30m (100ft), a horizontal standpipe system shall be installed on the structure in accordance with the requirements of Chapter ~~9~~10.

Substantiation: Erratum.

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502- Log #71  
(6.6.1)

Final Action:

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Submitter: Adrian Cheong, Land Transport Authority

Recommendation: Revise text to read as follows:

... requirements of Chapter ~~9~~ 10.

Substantiation: Wrong reference was made.

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502- Log #8  
(6.8.1)

Final Action:

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Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Revise text to read as follows:

On bridges and elevated highways, drainage systems to channel and collect spilled hazardous or flammable liquids shall be designed to drain to areas that cannot cause additional hazards.

Substantiation: Sentence is difficult to understand. Does it mean that areas which can cause additional hazards should not be drained? If so, what is an area that can cause an additional hazard and why must it be drained? Or is there an error and the text should read as proposed?

502- Log #85  
(7.x, and 7.xx (New) )

Final Action:

Submitter: Gary L. English, Seattle Fire Department

Recommendation: Add new text to read as follows:

7.XX& Materials that are combustible or pyrolyse at temperatures that may be found in the tunnel shall not be permitted.

A.7.XX Temperatures that occur in tunnels may significantly exceed temperatures found in other road structures, therefore the use of commonly accepted materials may combust or pyrolyse if used in a road tunnel. E.g. asphalt paving may burn or pyrolyse during a road tunnel fire. Materials that are combustible, or pyrolyse may be used outside the tunnel provided their use does not impact the tunnel environment in case of fire.

Substantiation: Current language does not preclude materials that will pyrolyse or combust at the extraordinary temperatures found inside the tunnel. The proposed language and annex provides needed language and explains why. Also, the use of these products outside the tunnel where they will not negatively impact the tunnel environment should not be banned. Note if this is added to 502, the language in 7.12.4 could be removed. Note that 7.12.4 only applies to drainage.

502- Log #9  
(7.1.2)

Final Action:

Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Revise text to read as follows:

In the design and operation of the tunnel, ~~the interdependence of measures~~ can be primarily intended to protect the structural elements of the tunnels from the effects of fires, ~~or and those measures primarily intended~~ to ensure the protection of life as well as of the structural elements of the tunnel, ~~shall be considered.~~

Substantiation: No guidance is available on how to assess interdependence, nor is there evidence interdependence exists.

502- Log #11  
(7.2)

Final Action:

Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Revise text to read as follows:

(2) Category A – Where tunnel length is 90 m (300 ft) or greater, standpipe systems and traffic control systems shall be installed in accordance with the requirements of Chapter ~~10~~ 10† and; Section 7.6 ~~and Chapter 12, respectively.~~

Substantiation: Erratum.

502- Log #12  
(7.2)

Final Action:

Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Revise text to read as follows:

(5) Category D – Where the tunnel length equals or exceeds 1000 m (3280 ft), or for a bi-directional tunnel exceeds 300 m (1000 ft), all provisions of this standard shall apply.

Substantiation: Bidirectional tunnels are inherently more dangerous than mono-directional tunnels. There is a greater risk of a traffic accident, longitudinal ventilation is impractical and fire brigade access more difficult since traffic is blocked at both portals.

502- Log #13  
(Table 7.2)

Final Action:

Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Revise text to read as follows:

- Manual fire alarm boxes ~~7.4.1.2~~<sub>3</sub>
- Telephone ~~7~~.4.5
- Fire standpipe ~~7-7~~10.1
- Water supply ~~9~~10.2
- Fire department connections ~~9~~10.3
- Hose connection ~~9~~10.4
- Fire pumps ~~9~~10.5
- Portable fire extinguishers ~~7.8~~9
- Water-based fire-fighting system ~~7~~.9
- Emergency ventilation system ~~7.10~~1
- Tunnel drainage system ~~7.11~~2
- Hydrocarbon detector ~~7.11~~2.7
- Emergency egress ~~7.11~~15.1.1
- Exit identification ~~7.11~~15.1.2
- Tenable environment ~~7.14.2/7.14.4.3~~7.15.2
- Emergency exits ~~7.11~~15.6
- Electrical Systems
- General ~~11~~2.1
- Emergency power ~~11~~2.4
- Emergency lighting ~~11~~2.6
- Exit signs ~~11~~2.6.8
- Security plan ~~11~~2.7
- Emergency response plan ~~12~~3.3

<sup>b</sup>If required, must follow Section ~~9~~10.5.

<sup>c</sup>If installed, must follow Section ~~7~~.9.

<sup>d</sup>Section ~~10~~1.1 allows engineering analysis to determine requirements.

Substantiation: These are errata identified in the 2011 edition.

502- Log #14  
(Table 7.2)

Final Action:

Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Revise text to read as follows:

Water-based fire-fighting system<sup>c</sup> ~~9 NMR NMR NMR NCMR~~ EMR

Substantiation: Long and busy tunnels present an enhanced risk of a major fire incident, with fire spread between vehicles. Although those present in the tunnel should evacuate before conditions become fatal, as the tunnel becomes longer it is increasingly unlikely that fire-fighters will be able to arrive in time to assist with evacuation. Thus the risk to tunnel occupants increases. It is also more likely that the fire will have grown to the point where fire-fighters cannot access the tunnel, so that the risk of a fire becoming a major fire increases and the risk to fire-fighters increases. A major fire can lead to a long-term closure even if the tunnel structure is protected from collapse by insulation. Road surfaces, lighting and ventilation will all need repair. For all these reasons the longest and busiest tunnels should be protected by a water-based fire fire-fighting system, while it should be considered for category C tunnels.

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502- Log #68  
(Table 7.2)

Final Action:

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Submitter: Ian E. Barry, IEB Consulting Ltd.

Recommendation: Add text into Table 7.2 under the section on Fire Protection

Structural Fire Protection NFPA Section 7.3 Tunnel Categories (to be discussed at the Technical Committee meeting)

Substantiation: There is currently no reference to the requirements for structural fire protection in the table although there is a reference section in the standard under 7.3 together with substantial annex material.

Also, The table suggests that there is a fundamental assumption that short tunnels require fewer fire protection systems or provision of fire and life safety systems than longer tunnels. This assumption is based purely on tunnel length and not the operational conditions for each individual tunnel.

For example, the operational risks associated with a short tunnel with Average Annual Daily Traffic figures of 100,000 vehicles and high % volumes of HGV's logically has a higher operational risk than a long tunnel with an AADT of 20,000 vehicles and restrictions to HGV's and dangerous/hazardous goods travelling through it.

This issue should be considered in discussions within TG12 – QRA and presented to the technical committee.

502- Log #1  
(7.2, Table 7.2, and 7.3.1)

Final Action:

Note: This Proposal originates from Tentative Interim Amendment 502-11-1 (TIA 983) issued by the Standards Council on October 20, 2010.

Submitter: Technical Committee on Road Tunnel and Highway Fire Protection,

Recommendation: 1. *Revise Section 7.2 to read as follows:*

7.2 Application.

7.2.1 For the purpose of this standard, factors described in 4.3.1 shall dictate fire protection and fire life safety requirements. The minimum fire protection and fire life safety requirements are based on tunnel length as categorized below. These minimum requirements, which are more fully described within this Standard, are summarized in Table 7.2.

- (1) Category X — Where tunnel length is less than 90 m (300 ft)
- (2) Category A — Where tunnel length is 90 m (300 ft) or greater
- (3) Category B — Where tunnel length equals or exceeds 240 m (800 ft)
- (4) Category C — Where the tunnel length equals or exceeds 300 m (1000 ft)
- (5) Category D — Where the tunnel length equals or exceeds 1000 m (3280 ft)

2. *Add a new 7.2.2 as follows:*

7.2.2 Table 7.2 identifies certain systems as “Conditionally Mandatory” for some tunnel categories. The determination (condition) of whether these systems are necessary or not shall be based upon an engineering analysis addressing the factors outlined in 4.3.1.

3. *Add a new item to appear as the first entry in Table 7.2 as follows:*

INSERT TABLE HERE

4. *Revise the first sentence in 7.3.1 to read as follows:*

7.3.1 Where required by Table 7.2 or 7.2.2, acceptable means shall be included within the design of the tunnel to protect all primary structural concrete and steel elements in accordance with this standard in order to:

**Substantiation:** This correction eliminates the inclusion of system requirements within the definition of the tunnel categories in the 2011 Edition of the standard. Tunnels will be defined based on their length as outlined in Section 7.2. The required systems for these tunnel categories will be outlined in Table 7.2. The proposed changes will further clarify the intent of structural protection for Category X tunnels in the 2011 edition. In addition the paragraphs in Section 7.2 were revised to eliminate confusion and clarify the Standard.

**Emergency Nature :** The 2011 Edition of the document contains a conflict within the document as Category X tunnels are not intended to comply with Section 7.3.2 unless a rational analysis indicates that it is necessary. Although this was the intent of the committee, this condition is not explicitly spelled out in the document. The proposed changes will ensure that the document is interpreted correctly and that Section 7.3 applies as a conditionally mandatory requirement for Category X tunnels while 7.2.2 spells out what the condition is.

### Tunnel Categories

	NFPA 502 Sections	X <i>[See 7.2(1).]</i>	A <i>[See 7.2(2).]</i>	B <i>[See 7.2(3).]</i>	C <i>[See 7.2(4).]</i>	D <i>[See 7.2(5).]</i>
<b>Fire Protection Systems</b>						
<b>Protection of Structural Elements</b>	7.3	CMR	MR	MR	MR	MR

502- Log #69  
(7.3)

Final Action:

Submitter: Ian E. Barry, IEB Consulting Ltd.

Recommendation: Revise text to read as follows:

7.3 Protection of Structural Elements

7.3.1 Regardless of tunnel length, acceptable means shall be included within the design of the tunnel to protect all primary structural concrete and steel elements in accordance with this standard in order to:

(1) Maintain Life Safety

(2) Mitigate structural damage and prevent progressive structural collapse

(3) Minimize economic impact

7.3.2\* The structure shall be capable of withstanding the rapid rise in temperature in line with the Rijkswaterstaat (RWS) time-temperature curve or other recognized standard time-temperature curve that is acceptable to the AHJ following an engineering analysis and Quantified Risk Assessment (QRA)

7.3.3 During a 120 minute period of fire exposure, the following failure criteria shall be satisfied:

(1)\* Tunnels with concrete structural elements shall be designed such that ~~explosive~~ spalling is prevented

(2) Steel or cast iron tunnel linings shall be protected ~~such that the lining temperature shall not exceed 300°C (572°F)~~ in order to prevent loss of strength of the element and structural collapse

7.3.4 Structural fire protection material, where provided, shall satisfy the following performance criteria:

(1) Tunnels with cast in-situ concrete structural elements shall be protected such that:

(a) The temperature of the concrete surface does not exceed 380°C (716°F).

(b) Tunnels constructed using high strength pre-cast, pre-stressed concrete shall be protected such that spalling is prevented (irrespective of the concrete surface temperature).

(c) Steel or cast iron tunnel linings shall be protected such that the lining temperature shall not exceed 300°C (572°F).

(d) The temperature of the steel reinforcement within the concrete (assuming a minimum cover of 25 mm (1 in.) does not exceed 250°C (482°F).

Substantiation: The proposed revised text clarifies the committee's intentions (for example – in 7.3.2 the structure does not withstand the RWS time-temperature curve but the heating regime associated with it. I have also differentiated between the performance of cast in place concrete and pre-cast, pre-stressed high strength concrete under fire exposure conditions. I propose removing the term "explosive" from the statement on spalling since this term is confusing to AHJ's. I propose that "explosive" is either removed completely or replaced with the term "progressive".

I also propose adding a new (a) in section 7.3.1 in order to be consistent with the corresponding section 6.3.1 in the standard "Bridges and Elevated Highways".

I propose that the remainder of section 7.3.4 is unchanged.

502- Log #90  
(7.3 and 7.3.5)

Final Action:

Submitter: Gary L. English, Seattle Fire Department

Recommendation: Revise text to read as follows:

7.3 Protection of Structural Elements, Passive Fire Protection and Fire and Life Safety Systems

7.3.5 Passive fire protection, and fire and life safety systems shall be protected from vehicle damage. An inspection and repair program shall be kept in force to monitor and maintain the structure and its protection.

Substantiation: Although significant text defines structural protection from fire, no specific requirement is stated for vehicle damage for passive fire resistance, and/or fire and life safety systems. It is necessary to change the section title to widen the section scope, and add new language under a new item 7.3.5. The requirement for an inspection and repair program ensures systems continue to work and is the same language from 8.4.2.

502- Log #15  
(7.3.2)

Final Action:

Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Add text to read as follows:

The structure shall be capable of withstanding the Rijkswaterstaat (RWS) time-temperature curve or other recognised standard time-temperature curve that is acceptable to the AHJ following an engineering analysis. This may be achieved by protection of the structure with board or spray insulation, or by using a water-based fire-fighting system in accordance with Chapter 9 to cool the structure, or by a combination of active and passive fire protection.

Substantiation: The aim of this clause is to ensure that measures are taken to prevent structural collapse in a fire. This can be achieved by protecting the tunnel with a water-based fire-fighting system to prevent exposure of the tunnel structure to excessive temperatures for long periods.

502- Log #39  
(7.3.4(2))

Final Action:

Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise text to read as follows:

7.3.4 Structural fire protection material, where provided, shall satisfy the following performance criteria:

(1) Tunnels with cast in situ concrete structural elements protected such that:

(a) The temperature of the concrete surface does not exceed 380°C (716°F).

(b) The temperature of the steel reinforcement within the concrete [assuming a minimum cover of 25 mm (1 in.)] does not exceed 250°C (482°F).

(2) The material shall be noncombustible in accordance with ASTM E 136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C, or by complying with internationally accepted criteria acceptable to the authority having jurisdiction when tested in accordance with ASTM E 2652, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C with a Cone-Shaped Airflow Stabilizer, ISO 1182, Reaction to fire tests for building and transport products - Non-combustibility test or BS 476-4, Fire tests on building materials and structures. Non-combustibility test for materials. equivalent internationally recognized standard.

(3) The material shall have a minimum melting temperature of 1350°C (2462°F).

(4) The material shall meet the fire protection requirements with less than 5 percent humidity by weight and also when fully saturated with water, in accordance with the approved time-temperature curve.

Also add a reference to ASTM E 2652, Standard Test Method for Behavior of Materials in a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750 Degrees C (2009a), ISO 1182 and BS 476-4 into Chapter 2 on referenced standards.

Substantiation: Note that authorities having jurisdiction throughout the world only recognize these standards for noncombustibility. This is consistent with the statement in A.3.3.37 of NFPA 502(see below)

The IMO (International Maritime Organization), ISO, the European Union, IEC, US Coast Guard and all US codes (ICC and NFPA) recognize no other tests for noncombustibility than the 4 described.

The language describing “equivalent internationally recognized standard” puts an undue burden on the ahj, who must then determine if the recommended test by a submitter is “equivalent”. Thus, the ahj could be forced into the position of either having to hire experts to determine what is equivalent or to accept tests that may not properly determine the fire performance required.

Note also that having been tested to a particular test standard does not mean that the material has passed the test, particularly since most standards do not contain criteria for “passing”. In fact, none of the tests mentioned in A.3.3.7 have criteria for “passing”; it is the ahj who sets the criteria.

**A.3.3.37 Noncombustible Material.** Standards other than ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, exist that are used to assess noncombustibility of materials. They include: ASTM E 2652, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C with a Cone-Shaped Airflow Stabilizer*; ISO 1182, *Reaction to Fire Tests for Building and Transport Products — Non-Combustibility Test*; and BS 476-4, *Fire Tests on Building Materials and Structures, Non-Combustibility Test for Materials*.

502- Log #70  
(7.4.1)

Final Action:

Submitter: Igor Y. Maevski, Jacobs Engineering

Recommendation: Revise text to read as follows:

7.4.1 Tunnels shall be equipped with fire alarm / fire detection system. Tunnels described in categories B, C, and D shall have at least one manual means of identifying and locating a fire in accordance with the requirements of 7.4.1.3. When water-based fire-fighting systems are installed in road tunnels an automatic fire detection system shall be provided in accordance with 7.4.1.4. Tunnels described in categories B, C, and D without 24-hour supervision shall have an automatic fire detection system in accordance with 7.4.1.4.

Substantiation: This will eliminate the conflict between the allowance for manual fire detection and requirements of section 9.1.2 for maintenance in accordance with NFPA 11, NFPA 13, NFPA 15, NFPA 16, NFPA 18, NFPA 25, and NFPA that require automatic fire detection. Water based fire fighting systems become useless and dangerous if not activated, or activated late spraying on hot concrete surface (creating post cooling concrete spalling). Tunnel operator watching the CCTV camera shall not be considered as a fire alarm / fire detection system (human factor shall be considered).

502- Log #80  
(7.4.1.3 and 7.4.1.3.6 (New) )

Final Action:

Submitter: Gary L. English, Seattle Fire Department

Recommendation: Revise text to read as follows:

7.4.1.3 Manual Fire Alarm Boxes / Emergency Telephones

7.4.1.3.6 Emergency telephones may be used in place of manual fire alarm boxes where the operation control center is continually staffed, or where lifting the phone receiver activates an equivalent response to a pull station activation.

Substantiation: Manual pull stations are used to notify OCC of a fire and may be used for initiating automatic systems. Replacing these with Emergency Telephones (ETels) provide same function as manual pull stations, but allow two way communications both for motorists and as an additional communication system for maintenance if emergency radios fail or are overused during an incident, and for emergency responders if needed.

502- Log #59  
(7.8)

Final Action:

Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Revise the heading and first sentence for 7.8 as shown below:

7.8 Standpipe, Hydrants, and Water Supply. Standpipe, ~~fire hydrants,~~ and water supply systems in road tunnels shall be provided in accordance with the requirements of Chapter 10.

Substantiation: Hydrants are not mentioned at all in Chapter 10 in fact "Standpipe and Water Supply" is the current title of Chapter 10.

502- Log #17  
(7.10)

Final Action:

Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Revise text to read as follows:

7.10 Water-Based Fire-Fighting Systems. See Chapter ~~109~~.

Substantiation: Erratum in Edition 2011.

502- Log #60  
(7.10)

Final Action:

Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Revise the heading for 7.10 as shown below:

7.10 Fixed Water-Based Fire-Fighting Systems. See Chapter ~~10~~ 9.

Substantiation: "Fixed Water-Based Fire-Fighting System" is the correct defined title for this system (3.3.29\*). This system is covered in Chapter 9 not Chapter 10.

502- Log #72  
(7.10)

Final Action:

Submitter: Adrian Cheong, Land Transport Authority

Recommendation: Revise text to read as follows:

... See Chapter ~~10~~ 9.

Substantiation: Wrong reference was made.

502- Log #83  
(7.12.4)

Final Action:

Submitter: Gary L. English, Seattle Fire Department

Recommendation: Revise text to read as follows:

7.12.4 ~~Polyvinyl chloride (PVC), fiberglass pipe, or other combustible material shall not be permitted~~ Materials that are combustible or pyrolyse at temperatures that may be found in the tunnel shall not be used.

Substantiation: The paragraph intent is to prohibit combustibles; however, material may pyrolyse without combustion and emit toxic, or combustible gases. In addition, newer versions of some products may be manufactured that do not create gases or contribute to combustion and should not be eliminated because they are a named product, therefore rather than banning a product by type, banning any materials that contribute to the fire load or pyrolyse will provide a better statement.

502- Log #40  
(7.12.4 and A.7.12.4)

Final Action:

Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise text to read as follows:

7.12.4\* The drainage system shall be constructed entirely of noncombustible materials. ~~Polyvinyl chloride (PVC), fiberglass pipe, or other combustible material shall not be permitted.~~

A.7.12.4 Examples of combustible materials that should not be used in drainage systems include plastic pipes of any kind (including poly(vinyl chloride (PVC), polybutylene or polyethylene) or fiberglass pipes. –

Substantiation: This section is best revised to make it clearer and the examples are then best moved to the annex. There is no need to identify specific materials in the body of the standard but it is best to ensure that the statement is clear in that the committee wishes all drainage system materials to be noncombustible materials.

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502- Log #88  
(8.2)

Final Action:

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Submitter: Gary L. English, Seattle Fire Department

Recommendation: Add new text to read as follows:

8.2 Application. Where required by the authority having jurisdiction, or, if the analysis under 4.3.1 determines the structure will act like a tunnel, the requirements of Chapter 4 shall apply.

Substantiation: Current language relies solely on the AHJ for a determination. Use of standard language from 4.3.1 will ensure an analysis to determine risk.

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502- Log #91  
(8.4.2)

Final Action:

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Submitter: Gary L. English, Seattle Fire Department

Recommendation: Add new text to read as follows:

8.4.2 Structural members, passive fire protection, and fire and life safety systems shall be protected from physical damage from vehicle impact. An inspection and repair program shall be kept in force to monitor and maintain the structure and its protection.

Substantiation: For Air Rights Structures, current language provides no requirement to protect the fire and life safety systems, and/or passive fire protection (if installed). What an operator perceives as minor, i.e. non important damage to a sprinkler pipe, fire detection wire or camera, OR, damaged passive protection could result in significant delay to detection, failure to suppress the fire, or similar event that could have detrimental effect, therefore the need for the inspection and repair program.

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502- Log #61  
(8.9)

Final Action:

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Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Revise the heading and first sentence of 8.9 as shown below:

8.9 ~~Standpipe, Hydrants, and Water Supply~~. Where the roadway beneath air-right structure length is 90 m (300 ft) or greater, ~~fire hydrants~~, standpipe, and water supply systems shall be provided in accordance with the requirements of Chapter 10.

Substantiation: Hydrants and fire hydrants are not mentioned in Chapter 10 and the title of Chapter 10 is "Standpipe and Water Supply" .

502- Log #62  
(Chapter 9)

Final Action:

Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Revise the title of Chapter 9 and the text in 9.1 General and 9.2 Design Objectives as shown below:

Chapter 9 Fixed Water-Based Fire-Fighting Systems

9.1\* General

9.1.1 Fixed Water water-based fire-fighting systems shall be permitted in road tunnels as part of an integrated approach to the management of fire and life safety,

9.1.2 When fixed water-based fire-fighting systems are installed in road tunnels, the fixed water-based fire-fighting system shall be installed, inspected, and maintained in accordance with NFPA 11 , NFPA 13, NFPA 15, NFPA 16, NFPA 18, NFPA 25, and NFPA 750 or other equivalent international standards.

9.2 Design Objectives.

9.2.1 The goal of a fixed water-based fire-fighting system shall be to slow, stop, or reverse the rate of fire growth or otherwise mitigate the impact of fire to improve tenability for tunnel occupants during a fire condition, enhance the ability of first responders to aid in evacuation and engage in manual fire-fighting activities, and/or protect the major structural elements of a tunnel

9.2.2\* Fixed Water water-based fire-fighting systems shall be categorized based upon their desired performance objective in 9.2.2.1 through 9.2.2.4.

Substantiation: Fixed Water-Based Fire-Fighting Systems is the defined system in 3.2.

502- Log #30  
(Chapter 9 and 10)

Final Action:

Submitter: Kenneth J. Harris, Parsons Brinckerhoff

Recommendation: Consolidate Sections 9 and 10 as shown.

\*\*\*\*Insert Include 502\_L30\_R Here\*\*\*\*

Substantiation: Sections 9 and 10 are currently treated separately, but in fact contain many common elements, particularly for supply and drainage. This proposal treats water-based suppression similar to that treatment given ventilation.

This is not original material; its reference/source is as follows:

Most of the material was authored by NFPA.

502- Log #76  
(9.1.1)

Final Action:

Submitter: Adrian Cheong, Land Transport Authority

Recommendation: Revise text to read as follows:

9.1.1\_ Water-based fire-fighting systems shall be permitted in road tunnels as part of an integrated approach to the management of fire and life safety.

Substantiation: There is a need to explain what we mean by integrated approach in this section.

## **9. Water-based Fire Fighting Systems**

**9.1 General.** Water-based tunnel fire fighting systems and tunnel operating procedures shall be developed to maximize the use of fire fighting systems to slow, stop or reverse the rate of fire growth, prevent the spread of fire to other vehicles, enhance the ability of first responders to aid in evacuation and engage in manual fire fighting activities and/or protect the major structural elements of a tunnel.

**9.1.1** Fixed fire fighting systems shall be permitted in road tunnels as part of an integrated approach to the maintenance of fire and life safety.

**9.1.2** The water-based fire fighting system operational procedures shall be designed to assist in the evacuation or rescue, or both of motorists from the tunnel.

**9.1.3** The water-based fire fighting system operational procedures shall be designed to protect the tunnel from structural collapse.

### **9.2 Criteria**

**9.2.1** The design fire heat release and growth rates produced by a vehicle(s) shall be used to design water-based fire fighting systems.

**9.2.2** The selection of the design fire heat release and growth rates shall consider the types of vehicles that are expected to use the tunnel.

### **9.3 Water Supply**

**9.3.1** Water-based fire fighting systems shall be connected to an approved water supply that is capable of supplying the system demand for 1 hour.

**9.3.2** Acceptable water supplies shall include the following:

1. Municipal or privately owned waterworks systems that have adequate pressure and flow rate and a level of integrity acceptable to the authority having jurisdiction.
2. Automatic or manually controlled fire pumps that are connected to an approved water source.
3. Pressure or gravity-type storage tanks that are installed, inspected and maintained in accordance with NFPA 22.

### **9.4 Fire Department Connections**

**9.4.1** Fire department connection shall be of the threaded two-way or three-way type or shall consist of a minimum of 100 mm (4 in.) quick connect coupling that is accessible.

**9.4.2** Each independent water-based fire fighting system shall have a minimum of two fire department connections that are remotely located from each other.

**9.4.3** Fire department connections shall be protected from vehicular damage by means of bollards or other approved barriers.

**9.4.4** Fire department connections shall be approved and shall be coordinated with emergency access and response locations.

**9.5 Fire Pumps.** Fire pumps shall be installed, inspected and maintained in accordance with NFPA 20.

### **9.6 Identification Signs**

**9.6.1** Identification signage for water-based suppression systems and components shall be approved by and developed with input from the authority having jurisdiction.

**9.6.2** Identification signage shall, as a minimum, identify the name and limits of the roadway that is served.

**9.6.3** Identifications signage shall be conspicuous and shall be affixed to, or immediately adjacent to, fire department connections and each roadway hose connection.

**9.7** Water-based tunnel fire fighting systems shall be inspected and maintained in accordance with NFPA 25.

### **9.8 Standpipe Systems**

**9.8.1** Standpipe systems shall be designed and installed as Class I systems in accordance with NFPA 14, except as modified by this standard.

**9.8.2** Where wet standpipes are required in areas subject to freezing conditions, the water shall be protected from freezing by heating and circulating and/or heat tracing.

**9.8.3** Heat trace materials shall be listed for the intended purpose and supervised for power loss.

**9.8.4** Dry standpipe systems shall be installed in a manner so that water is delivered to all hose connections on the system in 10 minutes or less.

**9.8.5** Combination air relief-vacuum valves shall be installed at each high point on the system.

**9.8.6** Hose connections shall be spaced so that no location in the protected roadway is more than 45 m (150 ft) from the hose connection.

**9.8.7** Hose connection spacing shall not exceed 85 m (275 ft).

**9.8.8** Hose connections shall be located so that they are conspicuous and convenient, but still reasonably protected from damage by errant vehicles or vandals.

**9.8.9** Hose connections shall have 65 mm (2 ½ in.) external threads in accordance with NFPA 1963 and the authority having jurisdiction.

**9.8.10** Hose connections shall be equipped with caps to protect hose threads.

### **9.9 Fixed Fire Fighting Systems**

**9.9.1 Design and Installation Standards.** Except as modified by this standard, fixed fire fighting systems shall be designed and installed in accordance with the appropriate NFPA Standard as noted.

**9.9.1.1** Foam-based fixed fire fighting systems shall be designed and installed in accordance with NFPA 11.

**9.9.1.2** Spray nozzle fixed fire fighting systems shall be designed and installed in accordance with NFPA 15.

**9.9.1.3** Foam-water based fixed fire fighting systems shall be designed and installed in accordance with NFPA 16.

**9.9.1.4** Wetting agent fixed fire fighting systems shall be designed and installed in accordance with NFPA 18.

**9.9.1.5** Mist fixed fire fighting systems shall be designed and installed in accordance with NFPA 750.

### **9.9.2 Design Objectives**

**9.9.2.1 System Classifications.** Water based fire-fighting systems shall be categorized based upon their desired performance objective.

**9.9.2.1.1 \*Fire Suppression System** Fire suppression is the sharp reduction in the heat release rate of a fire and the prevention of its re-growth by a sufficient application water. Fire size should remain reduced over the design discharge duration.

**9.9.2.1.2 \*Fire Control System** Fire control systems are intended to stop or significantly slow the growth of a fire within a reasonable period from system activation such that the total heat release rate does not substantially increase over discharge duration.

**9.9.2.1.3 \*Spread Prevention System**

**9.9.2.1.4 \*Volume Cooling System** Volume cooling systems are intended to provide [substantial] cooling of products of combustion but may or may not directly impact heat release rate.

**9.9.2.1.5 \*Surface Cooling System** Surface cooling systems are intended to provide direct cooling of critical structure, equipment or appurtenances without directly impacting heat release rate.

### **9.9.3 Design Requirements**

**9.9.3.1 Water application rate.** The water application rate shall be determined from engineering analysis for the Classification determined from 9.9.2.1.

**9.9.3.2 Tunnel ventilation.** The system performance shall be modeled with the design tunnel ventilation system operating at maximum capacity in such modes that the maximum airflow and/or velocity is flowing past the water application area.

#### **9.9.3.3 Nozzle spacing and placement**

**9.9.3.3.1** Nozzle spacing may be interpolated from test data at distances other than tested. Nozzle spacing beyond that in test data is not permitted.

**9.9.3.3.2** Nozzle placement shall consider tunnel geometry. Side spray nozzles are permitted to be used provided spacing and throw is within the maximum limits of tested data.

**9.9.3.3.3** Nozzles shall be spaced so that obstructions and shielding do not prevent the water application rate from being applied to all covered areas.

#### **9.9.3.4 Design and Installation Documentation**

**9.9.3.4.1** System design and installation documentation shall identify the working limits, parameters of the system, fire hazards and range of tunnel variables over which the system performance evaluation is valid.

**9.9.3.4.2** System documentation shall include recommended installation, testing, inspection and maintenance procedures and, by reference, the requirements of the relevant NFPA standard or equivalent standard acceptable to the AHJ.

**9.9.3.4.3** System documentation shall include an analysis of impact on the tenable environment including the effects of the nozzle spray on the smoke.

**9.9.3.5** System documentation shall include operating procedures for the system, particularly any delays in automatic activation.

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502- Log #29  
(9.2.2.3 (New) )

Final Action:

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Submitter: Kenneth J. Harris, Parsons Brinckerhoff

Recommendation: Add text to read as follows:

“Spread Prevention Systems” Spread prevention systems are intended to confine the fire to the initial incident. Vehicles involved in the initial incident may be destroyed, but the fire does not spread to other vehicles.

Note renumber subsequent paragraphs.

Substantiation: This strategy is an important one for mitigating the hazard from shielded fires where the spray does not impinge directly on the fire. By limiting the damage to the initial incident, fire duration is significantly shortened.

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502- Log #63  
(9.3.2)

Final Action:

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Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Revise the first sentence in 9.3.2 as shown below:

9.3.2 Fire test protocols shall be designed to replicate and evaluate the range of the application parameters associated with road ~~transportation~~ tunnels.

Substantiation: This standard addresses road tunnels only.

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502- Log #75  
(9.3.4 (New) )

Final Action:

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Submitter: Adrian Cheong, Land Transport Authority

Recommendation: Add new text to read as follows:

9.3.4 However, if deemed appropriate by the authority having jurisdiction, fire test protocols need not be carried out if the design of the water-based fire fighting system is in accordance with the test protocol of the full scale fire tests that had already been satisfactory conducted to demonstrate that the performance objectives as described in 9.2 and the tunnel parameters described in Section 9.4 have been met.

Substantiation: More and more full-scale fire tests with water-based fire fighting systems have been carried out in recent years. If -the authority having jurisdiction is agreeable that the design of the water-based fire fighting system for the new tunnel is in accordance with the test protocols of the full-scale fire tests that had already been conducted and satisfy with the results of the fire tests, the standards should not enforce on another expensive full-scale tests to be carried out.

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502- Log #64  
(9.6)

Final Action:

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Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Revise the text of 9.6 as shown below:

**9.6 Engineering Design Requirements.**

9.6.1\* When a fixed water-based fire-fighting system is included as part of the overall design of a road transportation tunnel, the impact of this system on other measures being part of the overall safety concept shall be evaluated. At a minimum, this evaluation shall address the following:

- (1) Impact on drainage requirements
- (2) Impact on tenability, including:
  - (a) Increase in humidity
  - (b) Reduction (if any) in stratification
- (3) Integration with other tunnel systems, including:
  - (a) Fire detection and alarm system
  - (b) Tunnel ventilation system
  - (c) Traffic control and monitoring systems
- (4) Incident command structure and procedures, including:
  - (a) Procedures for tunnel operators
  - (b) Procedures for first responders
  - (c) Tactical fire-fighting procedures
- (5) Protection and dependability of the fixed water-based firefighting system, including:
  - (a) Impact events
  - (b) Seismic events
  - (c) Redundancy requirements
- (6) Ongoing system maintenance and service requirements

Substantiation: Fixed Water-Based Fire-Fighting System is the defined system as shown in 3.2. This standard addresses road tunnels only.

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502- Log #78  
(10.4.2)

Final Action:

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Submitter: Gary L. English, Seattle Fire Department

Recommendation: Revise text to read as follows:

10.4.2 Hose connections shall be located immediately adjacent to emergency exits, spacing shall not exceed 45 85 m (150 275 ft). When required by the AHJ, the location of the connection at the egress shall be in the egress passage rather than in the tunnel.

Substantiation: Current spacing exceeds common fire hand line lengths, requiring additional time and effort to successfully lay a hand line. Current language does not require hose connections to be near a fire fighter access point. Current exit spacing greatly exceeds spacing requirement for hose outlets. This will result in firefighters entering the fire area from the protected exit, to find a hose outlet in the tunnel which could be 130 feet from the exit. Moving the hose outlet next to access and/or inside the exit will ensure rapid location and connection in a safe environment. A similar requirement for connection in a stairwell exists in high rise buildings.

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502- Log #73  
(11.1.1)

Final Action:

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Submitter: Adrian Cheong, Land Transport Authority

Recommendation: Revise text to read as follows:

Emergency ventilation shall not be required in tunnels ~~exceeding 240 m (800 ft)~~ less than 1000 m (3280 ft) in length, where it can be shown by an engineering analysis .....

Substantiation: The wording need to be revised as it suggests that as long as it can be shown by an engineering analysis, no emergency ventilation is required for the tunnel exceeding 240m in length.

The proposed revised wording is consistent with the requirements stipulated in Table 7.2 and the requirements for different categorization of tunnel length stipulated in Section 7.2.

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502- Log #81  
(11.1.4 (New) )

Final Action:

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Submitter: Gary L. English, Seattle Fire Department

Recommendation: Add new text to read as follows:

11.1.4 Emergency ventilation shall be sized to meet minimum ventilation requirements with one fan out of service, or, provide operational measures to ensure smoke management ensures life safety is not compromised with one fan out of service.

Substantiation: Currently, no allowance is required for routine or unexpected failure of any emergency ventilation fan. Designing the system to operate with one fan out of service will ensure either there is enough ventilation capacity to maintain safety in case of unexpected fan failure, a fan out of service for maintenance, OR, to reduce the fire load through operational constraints to a level where the fire load can be managed with remaining fans.

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502- Log #84  
(11.4.3 (New) )

Final Action:

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Submitter: Gary L. English, Seattle Fire Department

Recommendation: Add new text to read as follows:

11.4.3 Point extraction airflow rates are produced to prevent both back layering, and forward layering of smoke in the path of egress away from a fire (see Annex D).

Substantiation: With recognition of point extraction as a viable means of ventilation, controlling smoke from moving forward away from the fire and over stopped traffic in front of the fire is necessary. The suggested language is the same as existing 11.4.2, but adds new term of forward layering to describe this phenomenon. Relative additional language is added in Appendix D. . Note that in practice, point extraction is more accurately 'zone extraction' as the volume of air required to be extracted can far exceed practical limits of a single point. See proposed new Appendix D language.

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502- Log #36  
(Chapter 12)

Final Action:

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Submitter: Ed Morel, Genesis Transportaiton Lighting

Recommendation: In NFPA 502-2008 there is the following:

11.3 Materials

11.3.1 Materials that are manufactured for use as conduits, raceways, ducts, cabinets, and equipment enclosures and their surface finish materials, as installed, shall be capable of being subjected to temperatures up to 316°(600°F) for 1 hour without supporting combustion and without loss of structural integrity.

Substantiation: Is there anything in the current 2011 issue that replaces this? I have looked but have not seen anything.

In NFPA 502-2011 Chapter 12, Electrical Systems, there appears to be conflicts and contradictions regarding the wiring used in a tunnel. There have been installations that utilize electrical cord with quick disconnect type connectors (Brad Harrison or TPC). This is to facilitate both the ease of installation of the lighting system and if necessary, for maintenance reasons, the removal of a luminaire.

However, 502-2011 is not specific to this type of wiring and if it will be acceptable. Many agencies and design engineers are concerned about the legalities and safety of such wiring and would like to see it addressed more specifically.

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502- Log #41  
(12.2.1.3(3))

Final Action:

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Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise text to read as follows:

12.2.1.3 All wires and cables used in road tunnels shall be resistant to the spread of fire and shall have reduced smoke emissions by one of the following methods:

(1) All wires and cables shall be listed and shall comply with the FT4/IEEE 1202 exposure requirements for cable char height, total smoke released and peak smoke release rate of ANSI/UL 1685.

(2) Wires and cables listed as having adequate fire-resistant and low smoke-producing characteristics, by having a flame travel distance that does not exceed 1500 mm (4.9 ft), generating a maximum peak optical density of smoke of 0.5 and a maximum average optical density of smoke of 0.15 when tested in accordance with NFPA 262.

(3) Wires and cables complying with the requirements for class B2<sub>ca</sub> or better and class S2 or better when tested to EN 50399. Common test methods for cables under fire conditions - Heat release and smoke production measurement on cables during flame spread test - Test apparatus, procedures, results.

~~Wires and cables tested to equivalent internationally recognized standards approved by the AHJ.~~

Substantiation: The language describing "equivalent internationally recognized standard" without associated criteria puts an undue burden on the AHJ, who must then determine if the recommended test by a submitter is "equivalent".

Thus, the AHJ could be forced into the position of either having to hire experts to determine what is equivalent or to accept tests that may not properly determine the fire performance required. Therefore the issue should be whether the AHJ considers an alternate test to be acceptable, irrespective of whether it is equivalent.

Note also that having been tested to a particular test standard does not mean that the material has passed the test, particularly since most standards do not contain criteria for "passing".

The test proposed in (3) is equivalent to UL 1685 and is the test that is used in the European Union. The reference to Class B2<sub>ca</sub> refers to the flame spread (and/or heat release) and the reference to Class S2 refers to the smoke release.

This proposal deletes the reference to an unnamed international standard test "equivalent" to anything else, because such a requirement is unenforceable. An alternate proposal recommends some language that would retain the unnamed test but this proposal is the preferred one.

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502- Log #42  
(12.2.1.3(3) and (4))

Final Action:

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Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise text to read as follows:

12.2.1.3 All wires and cables used in road tunnels shall be resistant to the spread of fire and shall have reduced smoke emissions by one of the following methods:

(1) All wires and cables shall be listed and shall comply with the FT4/IEEE 1202 exposure requirements for cable char height, total smoke released and peak smoke release rate of ANSI/UL 1685.

(2) Wires and cables listed as having adequate fire-resistant and low smoke-producing characteristics, by having a flame travel distance that does not exceed 1500 mm (4.9 ft), generating a maximum peak optical density of smoke of 0.5 and a maximum average optical density of smoke of 0.15 when tested in accordance with NFPA 262.

(3) Wires and cables complying with the requirements for class B2<sub>ca</sub> or better and class S2 or better when tested to EN 50399, Common test methods for cables under fire conditions - Heat release and smoke production measurement on cables during flame spread test - Test apparatus, procedures, results.

(4) Wires and cables complying with the requirements based on an international fire test and set by the corresponding authority having jurisdiction tested to equivalent internationally recognized standards approved by the AHJ.

Substantiation: The language describing “equivalent internationally recognized standard” without associated criteria puts an undue burden on the AHJ, who must then determine if the recommended test by a submitter is “equivalent”.

Thus, the AHJ could be forced into the position of either having to hire experts to determine what is equivalent or to accept tests that may not properly determine the fire performance required. Therefore the issue should be whether the AHJ considers an alternate test to be acceptable, irrespective of whether it is equivalent.

Note also that having been tested to a particular test standard does not mean that the material has passed the test, particularly since most standards do not contain criteria for “passing”.

The test proposed in (3) is equivalent to UL 1685 and is the test that is used in the European Union. The reference to Class B2<sub>ca</sub> refers to the flame spread (and/or heat release) and the reference to Class S2 refers to the smoke release.

This proposal revises the reference to an unnamed international standard test “equivalent” to anything else, in spite of the belief that such a requirement is unenforceable. It recommends improved revised language. An alternate proposal, which is the preferred one, simply deletes the unnamed test.

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502- Log #43  
(12.3.1)

Final Action:

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Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise text to read as follows:

12.3.1 All wiring shall be protected by means of metallic armor/sheath, metal raceway, electrical duct banks embedded in concrete, or other methods approved by the AHJ, unless otherwise permitted by 12.3.1.1 or 12.3.1.2.

12.3.1.1 All wiring installed in ancillary facilities shall not require additional physical protection as described in 12.3.1 provided that they are installed in a cable tray and are listed for cable tray use.

12.3.1.2 All wiring installed in ancillary facilities shall not require additional physical protection as described in 12.3.1 provided that they are installed in a cable tray and are listed for riser use or for plenum use.

Substantiation: The National Electrical Code permits the use of wires and cables listed for plenum use and wires and cables listed for riser use to be installed in any application where cables listed for cable tray use are required. The reason for this is that wires and cables listed for riser use and listed for plenum use must comply with a more severe fire test than those listed for cable tray use. Cables listed for cable tray use must comply with the requirements of UL 1685 or IEEE/CSA FT4, those listed for riser use must comply with the requirements of UL 1666 and those listed for plenum use must comply with the requirements for both flame spread and smoke development based on testing to NFPA 262 (see the requirements in NFPA 502 12.2.1.3).

This section deals with ancillary facilities and not tunnels.

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502- Log #44  
(12.3.2)

Final Action:

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Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise text to read as follows:

12.3.2 All wiring, raceways, equipment, and supports installed in a road tunnel and ancillary areas shall meet the following:

(1) ~~PVC Combustible~~ coatings of any type shall not be permitted on exposed metallic armor/sheath, wiring, raceways, equipment, or supports.

(2) ~~PVC Combustible~~ conduits shall be permitted when covered with a minimum of 100 mm (4 in.) concrete when approved by the AHJ. All conduit ends inside of pull boxes and junction boxes shall be fire stopped.

(3) All insulated cables and conductors installed in supply air duct shall be enclosed in a metal raceway, or be Type MI cable, or Type MC cable employing a smooth or corrugated impervious metal sheath. ~~PVC coatings of any type shall not be permitted:~~

**Substantiation:** The real issue here is that the committee wishes no combustible coatings to be exposed to the airflow in road tunnels and ancillary areas. There is no need to identify PVC or any other combustible materials.

The original item (1) states that PVC coatings are not permitted on any exposed materials or products. As modified it addresses wiring as well. Since the committee does not wish to have exposed combustible products (including PVC products), wiring should be added to that sub-section. On the other hand item (3) relates to items that are enclosed in a metal raceway or otherwise not exposed; therefore there is no need to ban any specific wiring (including PVC wiring) from those areas, since they will not be exposed to the airflow.

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502- Log #45  
(12.3.3 and A.12.3.3.(1) (New) )

Final Action:

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Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise text to read as follows:

12.3.3\* All wiring and cables installed in supply air ducts shall meet one of the following:

- (1)\* Shall be listed as having adequate fire-resistant and low smoke-producing characteristics when tested in accordance with NFPA 262 ~~or equivalent international recognized standard~~
- (2) Shall be installed in nonmetallic conduits that are embedded in concrete with all conduit ends fire stopped where they enter pull boxes or splice boxes
- (3) Shall be installed in intermediate metal conduit, or rigid metal conduit without an overall nonmetallic covering, or flexible metallic tubing no longer than 6 ft in length
- (4) Shall be Type MI cable, or Type MC cable employing a smooth or corrugated impervious metal sheath without an overall nonmetallic covering

A.12.3.3 (1) One method of defining a cable that is low smoke-producing cable and fire-resistant cable is that the cable exhibits a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.52 m (5 ft) or less when tested in accordance with NFPA 262.

Substantiation: The language describing “equivalent internationally recognized standard” without associated criteria puts an undue burden on the AHJ, who must then determine if the recommended test by a submitter is “equivalent”. Thus, the AHJ could be forced into the position of either having to hire experts to determine what is equivalent or to accept tests that may not properly determine the fire performance required. Therefore the issue should be whether the AHJ considers an alternate test to be acceptable, irrespective of whether it is equivalent.

Note that the wiring and cables to be permitted in air ducts must exhibit very high performance in terms of both flame spread and smoke release. The language of “adequate fire-resistant and low smoke-producing characteristics” originates in the National Electrical Code. It is associated with wires and cables listed for use in spaces used for air-handling spaces as plenums.

All other wiring and cables must be in metal conduit or encased in concrete. There is consensus that no wiring and cable exists internationally that is equivalent (or more severe) than NFPA 262.

Note also that having been tested to a particular test standard does not mean that the material has passed the test, particularly since most standards do not contain criteria for “passing”, and that includes NFPA 262. In fact the acceptance criteria for plenum cables can be found in NFPA 90A, the National Electrical Code and the listing requirements. Therefore, the annex note proposed to be added to 12.3.3 (1) clarifies what the pass/fail requirements for plenum cables are.

An alternate, less desirable, proposal offers wording regarding the “equivalent internationally recognized standard” that is preferable.

502- Log #46  
(12.3.3 and A.12.3.3(1) (New) )

Final Action:

Submitter: Marcelo M. Hirschler, GBH International

Recommendation: Revise text to read as follows:

12.3.3\* All wiring and cables installed in supply air ducts shall meet one of the following:

(1)\* Shall be listed as having adequate fire-resistant and low smoke-producing characteristics when tested in accordance with NFPA 262 ~~or equivalent international recognized standard~~

(2) Shall comply with the requirements based on an international fire test and set by the corresponding authority having jurisdiction when tested to a fire test of equivalent severity

(3) Shall be installed in nonmetallic conduits that are embedded in concrete with all conduit ends fire stopped where they enter pull boxes or splice boxes

(4) ~~(3)~~ Shall be installed in intermediate metal conduit, or rigid metal conduit without an overall nonmetallic covering, or flexible metallic tubing no longer than 6 ft in length

~~(4)~~ (5) Shall be Type MI cable, or Type MC cable employing a smooth or corrugated impervious metal sheath without an overall nonmetallic covering

A.12.3.3 (1) One method of defining a cable that is low smoke-producing cable and fire-resistant cable is that the cable exhibits a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.52 m (5 ft) or less when tested in accordance with NFPA 262.

Substantiation: The language describing “equivalent internationally recognized standard” without associated criteria puts an undue burden on the AHJ, who must then determine if the recommended test by a submitter is “equivalent”.

Thus, the AHJ could be forced into the position of either having to hire experts to determine what is equivalent or to accept tests that may not properly determine the fire performance required. Therefore the issue should be whether the AHJ considers an alternate test to be acceptable, irrespective of whether it is equivalent.

Note that the wiring and cables to be permitted in air ducts must exhibit very high performance in terms of both flame spread and smoke release. The language of “adequate fire-resistant and low smoke-producing characteristics” originates in the National Electrical Code. It is associated with wires and cables listed for use in spaces used for air-handling spaces as plenums.

All other wiring and cables must be in metal conduit or encased in concrete. There is consensus that no wiring and cable exists internationally that is equivalent (or more severe) than NFPA 262.

Note also that having been tested to a particular test standard does not mean that the material has passed the test, particularly since most standards do not contain criteria for “passing”, and that includes NFPA 262. In fact the acceptance criteria for plenum cables can be found in NFPA 90A, the National Electrical Code and the listing requirements. Therefore, the annex note proposed to be added to 12.3.3 (1) clarifies what the pass/fail requirements for plenum cables are.

An alternate, preferred, proposal eliminates the statement about the “equivalent internationally recognized standard”, which is unenforceable.

502- Log #66  
(Table A.1.6.1)

Final Action:

Submitter: Arthur G. Bendelius, A&G Consultants, Inc.

Recommendation: Insert the following SI Conversion into Table A.1.6.1:

1 footlambert (ft) 3.415457 Candela/square meter (cd/m<sup>2</sup>)

Substantiation: This conversion is employed with the NFPA 502 document.

502- Log #4  
(A.3.3.37)

Final Action:

Submitter: John A. Dalton, W.R. Grace

Recommendation: Revise text to read as follows:

**A.3.3.37 Noncombustible Material.** Standards other than ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, exist that are used to assess noncombustibility of materials. They include: ASTM E 2652, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C with a Cone-Shaped Airflow Stabilizer*; ASTM E 1354 - 11 Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter; ISO 1182, *Reaction to Fire Tests for Building and Transport Products — Non- Combustibility Test*; and BS 476-4, *Fire Tests on Building Materials and Structures, Non-Combustibility Test for Materials*.

Substantiation: The E136 test is not the only appropriate test method for determining the non-combustibility of fireproofing products, including spray-applied fireproofing. Alternate and more effective evaluation methods exist, such as ASTM E-1354. As long as fireproofing products meet the surface finish criteria per ASTM E-84, the IBC requires that fireproofing products, tested according to ASTM E-119 to be approved in all types of construction. For perspective: Gypsum wallboard does not pass ASTM E-136 and is accepted wherever noncombustible materials are required.

502- Log #10  
(A.7.1.2)

Final Action:

Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Revise text to read as follows:

~~Measures used to protect the structural elements and nonstructural elements of a tunnel may change the heat flux characteristics of the area of the tunnel by changing the rate of energy flow in the area of the measures. Such measures for protecting elements of the tunnel can be very effective in protecting these elements from failure during a fire. They range from protective linings by which inhibiting heat flux to sacrificial coatings and sacrificial additives within the concrete that consume energy through phase changes within the concrete, to water-based fire-fighting systems that cool the structure and the tunnel environment.~~

~~In changing these heat flux characteristics these measures necessarily have the potential to alter the tunnel environment.~~

~~These changes should be considered when ensuring that life is protected within the tunnel during the evacuation and rescue phases.~~

~~Conversely, measures used to ensure life is protected may also alter the measures necessary to protect the structural and nonstructural elements of the tunnel by likewise altering the heat flux (such as via phase changes in water where water-based fire-fighting systems are used).~~

~~Accordingly, the interdependence of these measures must be considered in the design and operation of a tunnel.~~

Substantiation: A measure installed to protect the structure should be effective, so the second sentence is redundant.

The tunnel environment in a fire is of course primarily changed by the fire. Any additional effect on that environment during a fire from linings, coatings and sacrificial additives is secondary and need not be considered. A water-based fire-fighting system may be installed primarily to protect the tunnel structure, although it will bring an added benefit in improved life safety. This section is thus confusing and its call for an additional, unnecessary analysis should be deleted.

502- Log #16  
(A.7.3.2)

Final Action:

Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Revise text to read as follows:

A.7.3.2 Any passive fire protection material should satisfy the following performance criteria:

(1) Concrete slabs used for the application of passive fire protection materials

(3) The passive fire protection material is fixed to the concrete slab

(a) At the interface between the concrete and the passive fire protection material

The installation of passive fire protection materials should be done with anchors having the following properties:

Substantiation: Since fire protection could also be an active fire protection system, it should be clarified that this text relates to passive fire protection.

502- Log #31  
(A.9.2.2.3)

Final Action:

Submitter: Kenneth J. Harris, Parsons Brinckerhoff

Recommendation: Add text to read as follows:

Spread-prevention systems are designed to prevent the fire from spreading past the initial incident. It is most suitable for fires that may be shielded from the water spray, preventing direct impingement. Testing has shown that fires grow to a peak then begin a decline and decay. By preventing the spread to adjacent fuel piles, the peak heat release rate can be limited in duration, limiting the fire damage and duration and exposure to harmful combustion products.

Re-number subsequent paragraphs.

Substantiation: Substantiation of Standard proposal consistent with Annex treatment.

502- Log #32  
(A.9.3.1 and A.9.5.2)

Final Action:

Submitter: Kenneth J. Harris, Parsons Brinckerhoff

Recommendation: Delete both paragraphs in their entirety.

Substantiation: There is an abundance of literature on test results. Making testing mandatory may well have the unintended consequence of not providing these systems due to the costs of testing.

502- Log #18  
(Table A.11.5.1)

Final Action:

Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Revise table to read as follows:

Heavy goods truck 70-200 10-18

Heavy goods truck (5) 30 5-10

Notes:

(5) With an appropriate water-based fire-fighting system designed to achieve fire suppression or fire control in accordance with Chapter 9.

Substantiation: A water-based fire-fighting system can reduce the heat release rate from a tunnel fire, allowing the emergency ventilation system to be designed for a reduced heat and smoke release rate. This should be reflected in design guidance in the annex. 30 MW is the figure used by PIARC for heavy goods trucks. It is also the maximum heat release rate from a single bus.

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502- Log #86  
(Table A.11.5.1)

Final Action:

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Submitter: Gary L. English, Seattle Fire Department

Recommendation: Add new text to read as follows:

Table A.11.5.1 Note 5 For tunnels with more than two lanes, the geometry of the tunnel will determine the largest potential flammable liquid pool size and airflow. The pool size and the amount of available oxygen limits the fire heat release rate. This may result in heat release rates, greater than 300 mw in tunnels with larger cross section and/or mechanical or high natural ventilation.

Substantiation: New note 5 to ensure larger cross section tunnels recognize the possibility of a larger than 300 mw fire. A 4,000 gallon (US) spill has the potential to create a 2,000 mw fire for a short time, depending upon the pool size (surface area) and available oxygen. The 300 mw figure assumes a relatively small tunnel, e.g. 2 lanes which have a finite capacity of oxygen available to the fire and probably a limited pool surface area. A larger tunnel (3, 4, 5, 6 lanes wide) with a flat invert, could produce a dramatically larger pool and with much greater available O<sub>2</sub>. This could potentially result in a fire greater than the 300 mw identified in the table.

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502- Log #89  
(D.1)

Final Action:

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Submitter: Gary L. English, Seattle Fire Department

Recommendation: Revise text to read as follows:

D.1 General. The simultaneous solution of the following equations, by iteration, determines the critical velocity. The critical velocity,  $V_c$ , is the minimum steady-state velocity of the ventilation air moving toward a fire that is necessary to prevent backlayering or forward layering.

Substantiation: With recognition of point extraction as a viable means of ventilation, controlling smoke from moving forward away from the fire and over stopped traffic in front of the fire is necessary. The suggested language is the same as existing 11.4.2, but adds new term of 'forward layering' to describe this phenomenon which is similar to 'back layering'. A new definition for the term forward layering may be necessary. See proposed new 11.4.3.

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502- Log #19  
(E.3)

Final Action:

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Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Add text to read as follows:

(8) United Kingdom:

(a) Dartford Tunnels

(b) Tyne Tunnels

Substantiation: These tunnels now have water mist systems.

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502- Log #33  
(E.3)

Final Action:

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Submitter: Kenneth J. Harris, Parsons Brinckerhoff

Recommendation: Add text to read as follows:

Harris's paper, Water Application Rates for FFFS in Road Tunnels (ISTSS 2010) presented the theoretical basis of water suppression for HGV fires as well as application for the various strategies that can be considered. CFD modeling supported this basis.

Substantiation: E.3 as background has been written under the philosophy of when it is being done and why. Harris has shown a theoretical basis of operation as well as modeling results. Arvidson, in particular has demonstrated water application rates consistent with this modeling. The various mist testing programs have shown lower water application rates than generally prescribed. This technical analysis is an important step in moving from the philosophical justification to a technical description of what it does.

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502- Log #22  
(E.3.3)

Final Action:

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Submitter: Kenneth J. Harris, Parsons Brinckerhoff

Recommendation: Delete (1) Reduced stratification paragraph.

Substantiation: This has never been proven. Fire heat energy plus ventilation already provides significant destratification. It has never been demonstrated that stratification occurs over a long-enough duration to be significant and certainly not with the fire heat release rates described in Annex A.

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502- Log #20  
(E.4.1)

Final Action:

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Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Revise text to read as follows:

The installation of water-based fixed fire-fighting systems should be considered fitted in long or busy tunnels as in Table 7.2 and considered in other tunnels where an engineering analysis demonstrates that an acceptable level of safety can be achieved equal to or exceeded by the use of water-based fixed fire-fighting systems which are themselves and is a part of an integrated approach to the management of safety. The tunnel operator and the local fire department or authority having jurisdiction should consider the advantages and disadvantages of such systems as they apply to a particular tunnel installation.

Substantiation: Existing first sentence is meaningless. Second sentence is superfluous. Revised first sentence refers to Table 7.2, where this standard sets out for which tunnels a water-based fire-fighting system is mandatory and for which it is conditionally mandatory.

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502- Log #23  
(E.4.1)

Final Action:

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Submitter: Kenneth J. Harris, Parsons Brinckerhoff

Recommendation: Delete this paragraph.

Substantiation: Table 7.2 seems to make this superfluous.

502- Log #21  
(E.4.2)

Final Action:

Submitter: Alan Brinson, European Fire Sprinkler Network / Rep. International Fire Sprinkler Association

Recommendation: Revise text to read as follows:

The ~~sprinkler-system~~ piping should be arranged using interval zoning so that the discharge can be focused on the area of incident without necessitating discharge for the entire length of the tunnel. If foam is applied, Each zone should be equipped with its own proportioning valve set to control the appropriate water and foam mixture percentage. Nozzles should provide an open deluge and be spaced so that coverage extends to roadway shoulders and, if applicable, maintenance and patrol walkways. The system should be designed with enough water and/or foam capacity to allow operation of at least two zones in the incident area for a foam system and three zones for systems without foam.

Substantiation: The standard no longer uses the word sprinkler.

Many systems do not use foam.

Foam will control fire spread more effectively so two zones can be used. Without foam this section must be consistent with E.5.2 (5), which calls for three zones.

502- Log #24  
(E.4.2)

Final Action:

Submitter: Kenneth J. Harris, Parsons Brinckerhoff

Recommendation: Revise text to read as follows:

Zone length should be based on activation time ~~as determined by the authorities having jurisdiction~~ and should be coordinated with detection and ventilation zones.

Substantiation: Activation time is not determined by the AHJ. There are recognized industry practices for this.

502- Log #25  
(E.5.1)

Final Action:

Submitter: Kenneth J. Harris, Parsons Brinckerhoff

Recommendation: Delete this paragraph.

Substantiation: Water application rate is the cornerstone of most NFPA Standards. Suggesting it MAY be a valid design approach undermines this practice. The testing examples show rates that work, but provide no context for how well they worked.

502- Log #26  
(E.5.2)

Final Action:

Submitter: Kenneth J. Harris, Parsons Brinckerhoff

Recommendation: Delete Paragraph E.5.2.

Substantiation: These items can be addressed in the Standard.

(1) This is already stated in the Standard.

(2) This item provides no real guidance, just defers it to the AHJ.

(3) The implementation of nozzles to be within listing requirements is already stated in the various Standards.

(4) Zone length as a design parameter is more dependent on water supply availability and drainage than type of vehicle. The type of vehicle would more affect the number of zones operated.

(5) This is related to Item (4).

There is no justification or rationale supporting the water application rates for the Battery Street Tunnel or the Seattle I-90 and I5 tunnels.

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502- Log #74  
(E.5.2)

Final Action:

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Submitter: Adrian Cheong, Land Transport Authority

Recommendation: Revise text to read as follows:

(5) Hydraulic design for ~~three~~ two zones discharging simultaneously.

Substantiation: Amend to be consistent with E.4.2 'System Operation' which stated that 'the system should be designed with enough water and / or foam capacity to allow operation of at least two zones in the incident area'.

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502- Log #27  
(E.5.3)

Final Action:

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Submitter: Kenneth J. Harris, Parsons Brinckerhoff

Recommendation: Delete Paragraph E.5.3.

Substantiation: This paragraph provides no real information. The reality is water application rate is the significant element and many nozzles can provide the desired performance. The other items are all part of the system design and go into many more aspects than just nozzle selection.

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502- Log #28  
(E.6)

Final Action:

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Submitter: Kenneth J. Harris, Parsons Brinckerhoff

Recommendation: Delete Paragraph E.6.

Substantiation: Testing should not be required for individual systems. This procedure is more appropriate for a research test program and that would be outside the scope of 502.

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502- Log #3  
(M.1.2.15)

Final Action:

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Submitter: John F. Bender, Underwriters Laboratories Inc.

Recommendation: Revise text as follows:

M.1.2.15 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 1598, Luminaires, 2008, Revised 2010.

Substantiation: Reason: Update referenced standard to most recent revision.

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502- Log #35  
(M.1.2.15)

Final Action:

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Submitter: John F. Bender, Underwriters Laboratories Inc.

Recommendation: Revise text as follows:

M.1.2.15 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 1598, Luminaires, 2008, Revised 2010.

Substantiation: Reason: Update referenced standard to most recent revision.