

## **3M Transcript for the following interview: Ep 71: Bushfires & Respiratory**

### **Protection - Part 1**

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Welcome to the 3M Science of Safety podcast presented by 3M Australia and New Zealand Personal Safety Division. This is a podcast that is curious about the science and systems of all things work, health and safety, that keep workers safe and protect their health. I am Mark Reggers, an occupational hygienist, who likes to ask the questions Why, How, and Please Explain. Whether you are a safety professional, occupational hygienist, or someone with any level of WHS responsibility in the workplace, maybe you are a user of safety equipment or maybe you are a bit of a safety nerd who finds this stuff really interesting, then this is a podcast for you.

(R) Welcome back, Terry.

(G) Thanks Mark. Good to be back again.

(R) Good to have you back. Now, we're recording this in early 2020 and I think most people in Australia and New Zealand and around the world have seen the bushfires that have been ravaging a large part of Australia. And I know myself and you as well have a lot of questions around bushfire smoke and respiratory protection. So, we thought it might be good to delve a little bit deeper around this very specific hazard. So, for what we've just been through and obviously for future

fire seasons, unfortunately, when next year's summer rolls around, that people have a bit more information about what they can be doing, selection of products, but other controls. But to start off, can you please introduce yourself? Who are you, where are you from and what do you do?

(G) So, Mark, I'm a certified occupational hygienist. I've been working with 3M for over 20 years. Before that, in the government and doing consulting work; so, I've done occupational hygiene for far too long. Yes, and part of my remit at 3M is to look at PPE, the use, the testing, trials, etcetera, in workplaces to get the products out there and do the jobs they need to do.

(R) And make sure people are using these products, whatever they may be, correctly, because we are talking about PPE here, for the most part. And what does that rely on for it to be useful?

(G) People, unfortunately, and that's always a complication. People cut corners. People forget. People do things upside down, back to front or whatever. So, we are very much pushing the message that any PPE must be used properly, must be used according to the appropriate directions from the manufacturer or the supplier and otherwise it's not going to give you the protection that you would like it to.

(R) So, we are talking about bushfires and bushfire smoke. So, what is in bushfire smoke? What should people be aware of and maybe concerned with if you're a firefighter, for example?

(G) Yes, it's a bit of a cocktail. We're all fairly familiar ... it's smoke. So, there's a whole lot of particles in there; all the ash, all the soot, all the carbon-based material that is released from a fire. I'm sure many people have seen that falling from the sky at various times over the summer; burnt leaves. But of course, there's lots and lots of very small particles created and they're the ones that perhaps are more of an

issue in terms of exposure than the bits of leaf falling out of the sky. So, the particulate's certainly an issue. There are also a whole lot of organic materials that are burnt in the process; trees, sap, leaves, oils all getting decomposed by the fire and released into the atmosphere. So, they are also going to be there. The closer to the fire, obviously, the more of that exposure you're going to get, so some of this is going to vary depending whether you're talking five metres from the fire or five kilometres or 500 kilometres. Another significant material released is carbon monoxide, so any burning process involving carbon will involve oxides of carbon, so carbon monoxide and carbon dioxide are involved, and those levels are certainly measurable. Close to the fire, you can get significant exposures to CO. The other thing that researchers found that is significant is formaldehyde. So, this is a known human carcinogen, but again, it's created in that cocktail that is released and measurable amounts, again depending on the vegetation and how close you are, can be measured at the fire front, so firefighters need to be aware of that. And again, it's a question of the right protection.

(R) Depending on the moisture content of the bush, whether you're going to get more smouldering smoke, will obviously mix that cocktail of what may be coming off. I believe there's volatile organic compounds in there PAHs. There's a whole bunch of stuff.

(G) Absolutely. There's a gigantic cocktail of hydrocarbons of various sizes and shapes and toxicity for that matter. So, it's never simple. It will vary, as you say, depending on the temperature of the fire and let's say the dampness of the fire. All of these things come into play. The type of wood that's burning; they've done research in Western Australia and got somewhat slightly different results to what you would get on the east coast. Different types of forests, different types of species burning, slightly different outcomes; all in the same bucket overall, but it's like a fingerprint. You can get a different mix in the cocktail.

(R) Very different to a workplace where you've got the same machine running and you'd expect the same level of contaminant, where depending on those variables, it can change considerably depending on what and where you are. So, that's going to come into our respirator selection a bit further down the track, because there's a little bit of unknown there, from what you've said.

(G) Well, the whole process is chaotic, isn't it, so there's no guarantee of exposure levels, which you may get in a controlled workplace situation with known exposures and known controls. In a fire front, where the fire can be going in all directions and size and crowning through the treetops, your exposure's going to be wildly different depending on your location, wind direction, all of those things. So, it's clearly a complicated, variable exposure.

(R) Quite often, during bushfire season, you'll see the government and alerts and usually talk about PM2.5. What is that and how does that relate to bushfire smoke?

(G) PM2.5 is an abbreviation for PM, particulate matter, and 2.5 is the micron size of that material. So, it's an environmental measurement of air quality. The amount of PM2.5 in the air is an indication of the quality of the air that we all breathe.

(R) So, in the occupational hygiene circles, we talk about respirable dust being 10 micron and down. PM2.5 is looking at a very specific size range there.

(G) Yes. They're not directly comparable because there's different flow rates and different types of samples involved. So, they're not the same measurement in terms of the technicality of the measurement, but they are giving an indication of the air quality. So, clearly as PM2.5 gets higher and higher, there's more and more concern for the level of exposure for the exposed population.

(R) Looking at health effects from bushfire smoke exposure, from a firefighter point of view to maybe the general public, what are some of these things that people may experience from bushfire smoke exposure?

(G) Yes, there's certainly a whole suite of possibilities and I also suppose most of us have copped a face full of smoke at a barbecue or a bonfire or something over the years, so have some sort of appreciation of what's going on; irritation to the eyes and the throat, watering eyes. Over time, you can develop a headache because of the chemicals that are getting into your system. You can have breathing difficulties, coughing trying to clear the contaminants out of your lungs. All of these can come about to a perfectly healthy person. If you're somebody who's got some other medical issue, an asthmatic or someone with a lung condition, then those effects can be much earlier and much worse because of that underlying weakness. So, exposures to those people are of great concern.

(R) So, who would those people be specifically? You're more talking general public there in the background population of exposure.

(G) In general, I assume most firefighters are reasonably fit. I don't have any detail on that, but that would be my assumption. They should obviously protect themselves, but the people who are really at risk are the ones, as you say, further back, still getting too much smoke and aggravating their existing condition. Often, they'll be old, they'll be people who are infirm, people with some disability in respect of their lungs. And clearly, small children are at risk as well. They don't have a fully developed system that can deal with a level of exposure and therefore at risk earlier than a normal adult would be.

(R) Looking at the long-term health effects, you spoke about some of those contaminants being carcinogens, so firefighters in the long term, if they don't

adequately protect themselves during multiple fire seasons, they would be more at risk of cancers further down the track?

(G) I hesitate to make a call on that. Certainly, it's a concern. I agree with that. I haven't seen any specific data to give an indication if that's the case. I don't know of the work that's been done on volunteer firefighters who have been exposed over the years in that sense. So, I can't really go there. What I have seen is that professional firefighters are at risk to disease and cancer outcomes at an increased level to the general population. Their ongoing exposure over a number of years to a complicated cocktail, and for professionals, that can include building fires and chemicals of all sorts, these can lead to these bad outcomes. So, there certainly is a hazard there and there certainly is exposure. The size of that is perhaps unknown in terms of the bushfire scenario.

(R) Even if we don't know the finer detail, as you say, people can still do things to protect themselves to really ... as we say, that ALARP principle; wear those correct filters and respirators for what we do know there to put ourselves in a bit more higher confidence. But as you say, it's a very chaotic situation with any bushfire situation. So, doing the right thing with what we know is never going to be a bad thing.

(G) Sure, yeah, get the gear you can and for those who are further away, listen to the advice from the experts and the governments. Stay indoors, do those things that they're advised to do, that will reduce exposure and reduce those outcomes or potential health outcomes.

(R) Is there an exposure standard for bushfire smoke?

(G) There's those broad measurements, as we said, the PM2.5 as an indicator of air quality. There's no specific exposure standard that I know of for bushfire smoke as

a category. As we said earlier, it's a mixed cocktail of exposures. So, to get one number is impossible, I think, in that sense, but you can certainly look at the individual components, some of the ones we talked about, formaldehyde for example, or the total particulate exposure that you can get. Those can be measured and there are workplace standards for that. That can be looked at, or exposures can be looked at in those terms, but again, exposure standards for workplaces are for adults; healthy, fit, working adults. It does not necessarily apply to the general population that includes those susceptible groups; the ill and infirm, the old, the young.

(R) Can the hierarchy of control approach be used for bushfire smoke exposure, and I think you alluded slightly to it just before about not going out into a smoky environment. Are there other things that you can suggest to people, not just thinking about locking up the doors and that's the only thing you can do?

(G) There's going to be different situations that people are in. Their work may require them to get outside. The work may require them to do certain things, but the broad issue is to reduce your exposure to that, let's say, low quality air full of particulate that we do not want to breathe in, or we want to breathe in as little as we can. So, staying inside is the classic, simplest approach. We can keep the doors shut, keep the windows shut. The particulates essentially stay outside. The air inside is usually ... there's always exceptions ... the air inside though has usually much less particulate involved and therefore, lower exposure. Things like making sure you don't recycle air from the outside with your air conditioners. Put it on internal recycle, if you've got that function. Not everybody does. If you can, if you need to, you can get out of the house, get into your car, go to the local mall, the local shopping centre with nice air conditioning and filtered air. That can give you again, a few hours' break from that potential exposure. It might be more than just the particulate. It might be the heat and the wind and the weather as well. So, you can get a, if you like, a bit of a protection in a large facility like that. In terms of the

exposures in the workplace, let's call it the fire front, the guys and gals doing all that work, clearly, they need to be looked at in terms of what they're doing, how long they're on the front, the length of exposure, all of those things. They need to be assessed and people given rest breaks, given water, given appropriate recovery times. All those things need to be looked at by the management, the management teams of the fire, or the volunteers, or the professionals. Clearly, using the right PPE that is part of that reduction approach. It's sometimes not as simple as that when you're on active fire front and racing around and doing things under time pressure, but the more access, the more training people have to use this gear, then they can incorporate that into their operations.

(R) So, we spoke about all the nasties that may be found in bushfire smoke. Is there a respirator that is suitable for all those contaminants?

(G) Well, yes, in an impractical sense. One option is of course to wear a self-contained breathing apparatus, much as the fire brigade hazmat guys wear when they're responding to a chemical emergency, a truck overturn ...

(R) Building fire.

(G) ... building fire, that sort of thing, where again, you've got an unknown exposure, potentially high level, and they go in wearing the best protection you can get. A self-contained breathing apparatus has very high protection level and you've got your own clean, breathable air in the tank on your back. The downside, of course, is it's a finite supply. You've got maybe 30, 40 minutes, depending on the equipment you've got, so not long. It's heavy, relatively. You've got several kilos on your back and you're working in a hot and arduous situation. So, it's hard physical work at that point. The other issue is you can replace the air bottles again and again, but they need to be refilled, so there needs to be a way of supplying an ongoing supply of full air bottles for people to keep going. So, adding all those



things together, SCBA, while it has some advantages, in practice, it's impractical and not used broadly speaking. For specific applications, for short term, where you can spread the load, building fires etcetera, absolutely great. But in a bushfire situation where you're covering kilometres, hundreds of people, lots of units, it's impractical and can't be done.

(R) So, are there other types of respirators that may be suitable? If the SCBA is not practical, what could be suitable?

(G) Well, then we're looking at the mask situation, where people ... I'm sure everybody's heard or seen people wearing masks, N95s or P2s, as they're called. These are the rating of the mask, that means it's suitable for use against smokes and that particle size range that smokes come in. These makes, when used properly under the right conditions, can reduce your exposure significantly and give a level of protection. By no means perfect. By no means absolute protection, but it can improve the exposure to a lower level than would be without any mask or any protection.

(R) And we've spoken before that P1, P2, P3, that's for particulate matter. So, that wouldn't be suitable for those gases and vapours we alluded to, maybe for the frontline firefighters, where they may be some of that present. A P2 by itself, I'm assuming, would not be suitable.

(G) Well, it's not going to capture all those gases and vapours, as we said. They are there. The P2 mask or the N95 is particle rated, so it's only capturing particles. The gases and the vapours will go straight through. Capturing the particles is a good thing, so a P2 will do a job and reduce your particulate exposure. Those PM2.5s if you like are going to be at a lower level and that's a good thing. The level of gases and vapours is one of those variables that we talked about. We may or may not be exposed to significant amounts of that, but an N95 or a P2 particle

mask is a good start to deal with the particles. The gases and vapours is another step up and something that needs to be considered. Some fire fighters are wearing those masks, some are not. I've got to say there's a variable approach out there in the real world from the vision I've seen. I certainly haven't seen it all, but I'm confident to say that there's a mixed approach going on in terms of that level of protection that the fire crews have got access to and are using.

(R) What's N95? You've mentioned it a couple of times. How's that different to a P2?

(G) So, the P2 is the Australian Standard nomenclature for a mask that can deal with mechanically and thermally generated particulates, thermally meaning smokes in the context we're talking.

(R) Very small PM2.5, very small stuff.

(G) Exactly, the small stuff, as well as the big stuff. The N95 is the USA Standard equivalent of the P2. So, it's doing the same job, essentially the same mask in most cases. So, it again is a particle mask and dealing with those smokes and soots and ash particles that we are talking about.

(R) In Australia, I think the healthcare system refers a lot to the American USA rating system, so you will potentially see that N95 and P2 in Australia and around about. So, those people that are wearing these P2, and I think probably a good time to highlight that P2 or an N95 is a filtration rating level. It doesn't equate protection level and we've spoken about this a few times before. Correct filtration is one part of the equation for a wearer to achieve protection. So, for those people that have gone out and bought a P2 or N95 from a local distributor, what are the things that they should be thinking about, not just, "I've got the right filter."

(G) So, the mask itself is rated, as you say, appropriately. P2 or N95 is appropriate to deal with a level of particulate exposure. Under the Australian Standard, that sort of mask, a half mask as we call it, covering the mouth and the nose is rated to give at least a 10 times reduction in exposure, so it's going to knock down your exposure by a factor of 10. But there is a caveat to that. The mask must be worn and it must fit the wearer. The wearer must be clean-shaven or essentially so to allow for that mask to seal on that person's face and create a barrier, thereby all of the breathable air going through the mask rather than around the edge of the mask. So, we need that face seal to be working to give us an effective barrier and making sure we are filtering our inhaled breathing air.

(R) Quite often, I know doing training, and it comes up about that facial hair and different size particulates and gases and vapours where people are thinking about the smoke or the particulates that they can actually see. But with the PM2.5, this is the size. We're looking at 2.5 micron. We can't see that by the naked eye and on average, male facial hair, beard, stubble is going to be 125 to 150 microns versus 2.5. So, it's really important for our listeners and for those that are talking to other people, being clean-shaven and having that fit is so critical to achieve that overall protection that Terry was just talking about. And quite often, we need to remind people a respirator is not a set and forget. We don't put it on once and then we go about our day. It's moving because you're moving. You're probably doing work, physical, sweating, moving around. So, we need to be conscious of that mask that is on our face. Now, a question that comes up from time to time, Terry, in different workplaces that I've seen with the different firefighters that I've spoken to this year, when talking about P3 filter ... so we've got a higher efficiency than a P2 ... but when they wear a P3 filter on a half face mask, the Australian Standard says to treat that protection level as a P2 protection level. Why is that the case?

(G) It comes back to that facial fit that we just talked about. The filter will do its job. The P2 filter will do its job to its level. The P3 will do its job to its level,

capturing that particulate exposure. The weak spot in any tight-fitting mask, and in this case a half mask we're talking about, is that face seal. The most likely pathway of leakage is around that face seal and most exposure will occur because of that. The difference between the P2 and the P3 in terms of filtering performance becomes negligible. All of the exposure that we're concerned about while wearing that mask is because of face seal leakage. So, there's no improvement by using a P3 over a P2 because the face seal is still the crucial element. You're still relying on that face seal.

(R) It's that weakest link in the ...

(G) The weakest link in the chain, so you don't get any improvement to the exposure from going from a P2 to a P3 on a half mask. The Standard says either way, P2 or P3, you can only expect to get a minimum of 10 times reduction.

(R) So, for those firefighters who may be having some of those gases and vapours exposure, what class or category of gas vapour cartridge should they be looking at?

(G) There's, as we've said, a range of exposures in the gas and vapour category. The organic vapours are significant and therefore we look at thinking about some active material there to capture those organic vapours that are coming off the burning material. We mentioned formaldehyde as well before. That's of concern. Again, it's an organic vapour of type, but a carcinogen, so again, something that we need to be particularly considering. So, I know in several states, there are volunteers and even professional firefighters who are wearing an organic vapour and formaldehyde rated gas vapour filter plus that P2 rated particle filter, and that way, getting protection against a wide range of those gas vapour exposures we talked about, plus the particulates.

(R) So, there's that A form which I know that's a type of filter that 3M definitely has. You be looking at an ABE cartridge as well, depending on one of those two, would certainly capture a number of those gases and vapours.

(G) Yes, so under the Australian Standard, A type carbon is for organic vapours and B or form type carbon will capture formaldehyde. So, they've got a capacity to hold a certain amount. They still will not last forever. They're like a bucket, if you like. They'll hold a certain amount of those contaminants, so you still need to change them out when the bucket's full or before the bucket's full ideally, and so there is a certain service life involved. Again, that depends on the level of exposure and how long that might last. So, the specifics come into the argument there, but you've got the capability to deal with those contaminants with that type of filter.

(R) Well, that's part one of my chat with Terry. I hope you've enjoyed what we've spoken about so far. We'll continue our conversation in the next episode, so be sure to download and listen to that one as well.

(R) You can get into contact with the show by sending an email to [scienceofsafetyanz@mmm.com](mailto:scienceofsafetyanz@mmm.com) if you have any questions, topic suggestions or you'd like some assistance in your workplace around respirators and bushfires, or anything else in your workplace where PPE may be required. 3M are certainly here to help. You can also visit our website [3m.com.au/sospodcasts](http://3m.com.au/sospodcasts) for further resources on bushfire smoke and respiratory protection as well as the transcript of the chat that Terry and I have just had. Plus, it has all the information and similar resources for all the other episodes we have recorded. Be sure to subscribe, rate, review and share through Apple Podcasts, Spotify, Google Podcasts or wherever you get this podcast from. And as Alvin Loffler said, "You've got to think about the big picture things while you're doing the small things, so that the small things go in the right direction." Thanks for listening and have a safe day.