Fuel The Future: Risk Assessment

This is a 45-60min long show on the subject of sustainability and features several small and large scale demonstrations. These demonstrations will include all of, or some of, the below:

1. Fire in Hand
2. Burning Coal
3. CO2 Candle Extinguisher
4. Blue Sky
5. Hero's Engine
6. Hand Crank Generator
7. Steam Generator
8. Blowing Wind Generator
9. Solar Panel Explainer
10. Dissolving Chips
11. Hydrogen Balloon

Likelihood		Severity (of impact)		Current risk
Certain	5	Death or total destruction	5	Multiply Likelihood and Severity of impact to get Current Risk rating
High	4	Major injury or damage	4	
Medium	3	Serious injury or damage	3	
Low	2	Minor injury or damage	2	
Very low	1	Negligible	1	

Action Rating	
10 and above	The work is too dangerous and should not be undertaken
8 or 9	The work is high risk. Those undertaking the work must be fully competent and experienced for the type of work, equipment to be used and fully understand all risks present.

5 or 6	Moderate risk Workers must be fully competent for the type of work and risks present, or under competent supervision.
4	Low risk. Those undertaking the work must be aware or be made aware of the risks and mitigation measures required.
2 or 3	Slight risk. Those undertaking the work should be aware or be made aware of the risks and mitigation measures required.
1	Insignificant risk. Activity suitable for all workers

ACTIONS NEEDED BY VENUE:

Isolate Smoke/ Fire Alarms in vicinity of demonstrations (if possible)
Ensure presenter knows Fire Evacuations procedures
Ensure 1 x Fire Extinguisher is on Stand-by (only to be used in emergencies- should be either dry powder or carbon dioxide)

Risk assessed by: Dan Plane
Date of last review: Nov 2025
Review date: February 2027

Demonstration 1: Fire On Hand

Presenter bubbles butane gas through soapy solution causing bubbles. Some bubbles are scooped onto the hand and then ignited.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y		Y		

PPE Requirements

Item		Item		Item		Item	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection	Y		

Description of Hazard	Current Control Measures	Likelihood	Severity of Impact	Current Risk
Unintentional fire causing damage to building or persons	Hand held away from body. Arm held at shoulder height Hand to be kept flat Check no overhanging flammable items. No flammable items in vicinity of the demonstration. Bowl of bubbles to me moved from under hand / hand to be moved away from bowl before igniting bubbles . (To Side/ under table) Check non flammable floor covering Any long loose items to be tied back (hair, scarves.) If loose sleeves, long fire proof gloves to be worn. Remove jewellery from hand Safety Glasses to be worn.	1	2	2

	Audience to be minimum 2m away.. Assess area for any strong wind/ breeze.			
Risk of burns to presenter due to intentional ignition	Bubbles not to exceed 10cm high Hand submerged in water before grabbing bubbles Bubbles thoroughly wiped from underside of hand before setting alight	3	2	6
Faulty lighter presents the risk of burns	Inspect lighter before use. Refill away from public.	1	3	3
Incorrect use of butane and butane/propane mix can cause fire/explosion.	Butane should only be used in a well-ventilated space. Goggles will be worn when using the blowtorch. The butane used is available domestically, it is used as a lighter refill, however it should still be treated with respect. It will be sourced from a reputable supplier and canisters inspected for damage before use. Butane should be extinguished using oxygen restriction, or in an emergency, either dry powder or carbon dioxide extinguishers can be used. The gas used will be from domestic canisters: UN 2037 Safety data sheets can be found here; Butane: http://www.farnell.com/datasheets/1801831.pdf Butane/ Propane mix: http://www.partinfo.co.uk/files/2500%20Cartridge.pdf	1	4	4
Incorrect storage and transportation of butane and butane/propane mix can cause fire/explosion.	It will be stored in a non-conductive box at a temperature below 50°C and away from sources of ignition. There will be a maximum of 8 canisters stored at one point, but mostly only 4, unless a high number of shows are needed. Due to the butane being domestic canisters and the small volume carried/ stored, no special license or labelling is needed.	1	3	3

	Ideally the box containing the butane will be lockable, so if left unattended the gas cannot be accessed by others.			

Demonstration 2: Burning Coal

Method: Approximately 2-3 spatula scoops of potassium chlorate, an oxidizing agent, is placed into a boiling tube in a laboratory clamp and stand. It is then melted and heated with a blowtorch. Once melted, a spatula full of ground charcoal is put into the tube so that it drops into the molten potassium chlorate. It reacts violently with a shrieking noise, creating a bright light and lots of sparks and smoke. The blowtorch used will be fuelled with either Butane or a high temperature gas mix (MAP gas). Note: throughout risk assessment, when referring to butane it also applies to a butane/propane mix.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y		Y		

PPE Requirements

Item		Item		Item		Item	
Flameproof overalls		Gloves contact	Y	High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical	Y	Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection	Y		

Hazards and risks	Mitigation	Likeli hood	Severity of Impact	Current Risk
Eye injury via multiple possible causes. Chemical irritant, flames and sparks, and potentially broken glass.	Eye protection must be worn throughout.	1	4	4

A relatively large amount of smoke is produced, which could cause respiratory irritation. The smoke may also set off fire alarms.	The demonstration should be performed only in a well-ventilated environment and with audience members well clear (at least 3 metres). Smoke detectors in the same room should be isolated from the fire alarm system if possible. This is not a health and safety measure, but a matter of convenience, to prevent the need to unnecessarily evacuate the school.	4	1	4
Burning charcoal particles will be ejected from the boiling tube during the reaction, causing burn injury or the potential to start a fire.	The reaction must be performed behind a 3- sided polycarbonate screen. An exclusion zone is to be created, with audience members at least 3 meters away from the reaction. The clamp and stand must be secure and stable, and the whole demonstration space within the safety screen protected with heat-proof ceramic mats. Flammable materials must be kept well clear. If any material does escape the tube, it should be left to burn itself out on the ceramic mats. If the material escapes beyond the ceramic mats, it can be extinguished with a fire blanket, or water, foam, or CO_2 fire extinguisher, which must be on hand.	2	3	6
The flame produced may cause burn injury	A spatula will be used to drop the coal into the tube. Heat proof gloves are also to be used for inserting the coal, even though the gloves compromise dexterity. Presenters are to be correctly trained and be confident in performing the demonstration.	2	2	4
The tube will become extremely hot (around 400°C or more) it will remain hot for some time after the demonstration, risking burning injury.	The tube nor its contents is to be touched during, or immediately after the demonstration. Heavy, heat-proof gauntlets should be worn to handle the boiling tube in the unlikely event it needs to be handled. The entire clamp stand can be moved safely by handling the retort rod once the reaction has finished.	2	2	4

The tube may crack during the process, releasing its contents below.	The reaction must be carried out on ceramic mats. If the tube breaks, the contents should be allowed to burn out and cool in situ. If the potassium chlorate drops whilst still in powder form, carefully gather up and place in another boiling tube and burn off using another portion of charcoal dust.	2	2	4
The blowtorch creates a fire hazard.	The blowtorch/Bunsen must only be used by people trained and familiar with their correct use. The flame must only be on for as long as necessary. If using a blowtorch, the gas must be switched off as soon as the potassium chlorate is ready, and just before adding the charcoal to the tube.	3	2	6
Incorrect handling of potassium chlorate can cause skin and eye irritation, acute toxicity, or a fire/explosion.	Nitrile gloves and goggles should be worn when dispensing the potassium chlorate into the test tube. It will be kept away from food, and hands thoroughly washed before food consumption. All presenters to be familiar with the MSDS: Potassium Chlorate is an oxidizer, UN1485 therefore precautions must be taking according to the MSDS: PO4840_en_GB_4f4b.pdf (wf-education.com)	2	3	6
Incorrect storage of potassium chlorate can cause skin and eye irritation, acute toxicity, or a fire/explosion.	Ri to ensure that potassium chlorate will be sourced from a reputable supplier It will be stored and transported within a sealed container (ideally the one it is supplied in) and separate to fuel sources, the lid can be sealed with tape if needed, though if leaking a replacement container should be sourced. The container will be labelled with the chemical name (Potassium Chlorate) and the appropriate Hazchem information It will always be stored and transported in weights of 1kg of less (mostly even less than 500g) Transport by Land and Sea required no special conditions if quantity is kept to 1kg or below. It will be stored in a cool, dry, well ventilated area, and kept away from sources of heat, radiation, static electricity and food. As a further precaution it will be ‘double’ boxed i.e. kept in a box within a box such that if a spill	2	3	6

	occurs in the first, the second will catch the spill. Ideally, this box will be lockable, so if left unattended the potassium chlorate cannot be accessed by others.			
Incorrect disposal of potassium chlorate can cause fire/explosion, or cause environmental damage	Allow reaction to complete before discarding boiling tube and its contents in domestic general waste (the ratios used in this reaction should be such that all chlorate will have reacted with the coal)	1	1	1
Incorrect use of butane and butane/propane mix can cause fire/explosion.	Butane should only be used in a well-ventilated space. Goggles will be worn when using the blowtorch. The butane used is available domestically, it is used as a lighter refill, however it should still be treated with respect. It will be sourced from a reputable supplier and canisters inspected for damage before use. Butane should be extinguished using oxygen restriction, or in an emergency, either dry powder or carbon dioxide extinguishers can be used. The gas used will be from domestic canisters: UN 2037 Safety data sheets can be found here; Butane: http://www.farnell.com/datasheets/1801831.pdf Butane/ Propane mix:	1	4	4

	http://www.partinfo.co.uk/files/2500%20Cartridge.pdf			
Incorrect storage and transportation of butane and butane/propane mix can cause fire/explosion.	It will be stored in a non-conductive box at a temperature below 50°C and away from sources of ignition. There will be a maximum of 8 canisters stored at one point, but mostly only 4, unless a high number of shows are needed. Due to the butane being domestic canisters and the small volume carried/ stored, no special license or labelling is needed. Ideally the box containing the butane will be lockable, so if left unattended the gas cannot be accessed by others.	1	3	3

Demonstration 3: CO_2 candle extinguisher

3 tea lights are lit and placed onto a clear box with stepped shelves, one candle on each shelf. Then they pour approximately 200 ml of vinegar and 20g (one heaped teaspoon) of bicarb soda into a 3L jug. Stir quickly and leave to sit still while the reaction settles, and produces CO_2. The presenter then carefully lifts the jug and slowly pours the CO_2 onto the candles (aiming for the bottom step), taking care not to pour the liquid in the jug. The candles should go out, one at a time from the bottom to the top, as the CO_2 fills up the box.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y		Y		

PPE Requirements

Item		Item		Item		Item	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection			

Hazards and risks	Mitigation	Likelihood	Severity of Impact	Current Risk
Lighter can cause unwanted fires or burn injuries	Only presenter to use lighter. Lockable long handled lighter will be used where possible. Lighters to be stored away from flammables and oxidizers	1	1	1

Candles can cause unwanted fires or burn injuries	Only presenter to handle candles. Candles are not moved once lit and never left unattended. Ensure all candles are extinguished before moving on from the demo. Only use tealights with a stable base, and ensure the candle is upright and stable	1	1	1
Vinegar and/or bicarb can spill, causing a slip hazard	Presenter to be wary of slippery surfaces, and verbally warn any volunteers coming up on stage of potential hazard. Clean up at the earliest convenience.	2	2	4

Demonstration 4: Blue Sky

Method: A fish tank with up to 10 L of water is set on a turntable. With the long side facing the audience, a white torch is shone through the water from the short side. While still holding the torch at the end of the tank, the presenter adds approximately a teaspoon of milk to the water and mixes it around. The beam of light should appear blue. After a brief explanation, the presenter rotates the tank 90 degrees, so that the audience are now seeing the torch directly through the tank. The beam of light should appear yellow.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y		Y		

PPE Requirements

Item		Item		Item		Item	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection			

Hazards and risks	Mitigation	Likelihood	Severity of Impact	Current Risk
Water/milk can spill, causing a slip hazard	Presenter to be wary of slippery surfaces, and verbally warn any volunteers coming up on stage of potential hazard. Clean up at the earliest convenience.	2	2	4

An allergic reaction may occur if anyone is allergic to milk	The demonstration should be conducted by the presenter, and conducted at least 2 meters away from the audience to prevent the audience from coming into contact with milk. If the presenter has a milk allergy, they should inform the Ri and alternative arrangements will be made.	1	3	3
Container may break, leading to large water spill and creating a slip hazard	Containers provided will be made of plastic, to avoid shard of glass from being produced in the event of breakage. Check container for signs of wear prior to each show, and do not use if container has cracks in. A bucket should be used to transport water from the tap to the tank, so a slippery tank does not have to be carried across the venue, increasing the risk of water spillage through sloshing or dropping the tank	1	2	2
The tank could fall off the turn table, causing impact injury	A rubber mat is used between the tank and the turn table, so the tank does not slip, especially when weighed down with water. Presenter should turn the tank carefully	1	2	2
Carrying large volumes of water through the venue may cause risk of manual handling injuries	A bucket will be provided, so a 10L tank of water does not need to be carried over large distances. Correct manual handling procedures should be followed.	1	2	2
Using faulty electrical equipment (torch) can cause electric shocks	Conduct a visual inspection of torch before the show. Do not use if the torch has signs of damage. Store the torch in a cool, dry area.	1	1	1

Demonstration 5: Hero Engine

Hero Engine, suspended from the end of a pole by a magnet, is heated over a MAP blow torch held by a retort stand. The water inside the hero engine starts to heat until steam is expelled from the 2 arms causing the here engine to spin round.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y		Y		

PPE Requirements

Item		Item		Item		Item	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection	Y		

Hazards and risks	Mitigation	Likeli hood	Severity of Impact	Current Risk
Scalds from steam	Decorator pole ensures a safe distance between presenter and hero engine. Eye protection to be worn by presenter. Presenter to ensure audience at least 2 metres away from hero engine. Within about 1 meter the steam will have condensed and will be cool to the touch	2	2	4

Burns from blow torch	Torch only touched when lighting or when switching off. Presenter to put hands below flame not through flame. Minimal requirement to handle torch after turning off until it is cool. If blowtorch required to be moved grasp on body not torch head.	1	3	3
Canister falling setting fire to property	Cannister securely secured with retort stand Cannister is reasonably stable when stood on end without assistance. Blow torch is never left unattended when switched on. Fire Blanket available. Presenter to know location of fire extinguishers	1	4	4
Spills from water causing slips	Paper Towels available in schools. Clear up any spills asap Artists to monitor any volunteer movement around spills.	1	2	2
Explosion of gas canister due to fault/ overheating	Cannister visually checked before use for damage. Listen/ smell for any leaks Only approved cannisters used. Cannister conforms to latest UK regulations. Cannister only used for a short period of time. Cannister purchased from reputable supplier..	1	3	3
Gas leaking	Blow Torch not used in an enclosed area. Blow torch connection inspected for leaks before show, by sound and smell.	1	3	3
Hero Engine exploding	Presenter to inspect that pipes are not blocked before show. If In doubt blow through one pipe and check air comes out the other.	1	4	4
Connection holding up the hero engine during demonstration could fail	Hero engine is connected by superglue to a neodymium magnet and a steel ball bearing ball, which connects to another magnet taped to the pole. This provides a strong connection. Should connection fail, audience will be a minimum of 2m away from performance area.	1	3	3

	Blowtorch should be pointed so the hero engine is over the table, rather than over the floor, reducing the risk of a falling hero engine bouncing towards the audience.			

Demonstration 6: Hand crank generator

Method A hand cranked generator is used to build up a voltage which lights up an led light. This light is either placed in a top hat or in its own stand on a table. The light is a led in a plastic lightbulb casing. (Note- the ‘shorting’ plug can be used here so the key and button extension is not needed).
Note: Two different models of generator are in use by various presenters, so not all of the following will apply to every generator. All precautions are covered.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y		Y		

PPE Requirements

Item		Item		Item		Item	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection			

Hazards and risks	Mitigation	Likelihood	Severity	Current Risk

The magnet used inside the generator is powerful, and will attract magnetic objects very strongly. This could cause injury to body parts or damage objects caught in the way. This can happen very suddenly and very rapidly.	Ensure that the generator is stored away from other magnets. The operator of the generator (presenter or volunteer) cannot have any medical equipment on them that will be affected by magnetic fields. The demonstration will be performed at least 2 meters from the audience. If presenter cannot operate the generator, they will inform the Ri and other arrangements will be made.	2	3	6
Using faulty electrical equipment can cause electric shock injury	As a voltage is generated there is risk of electric shock. to prevent this, all wires will be fully insulated, and the volunteer will be advised to keep their hands away from the wires. If a shock does occur, it will be minimal current and would cause discomfort rather than harm.	1	2	2
The long wire from the generator to the light may create a trip hazard.	Ensure that these wires are placed away from thoroughfares or inserted only for the short time of this particular demonstration	1	1	1
Due to moving parts, there is a risk of pinch injuries	Presenter to ensure no fingers or loose objects can be caught prior to operating the generator. Loose scarves, lanyards etc. are to be removed.	2	1	2
The generator could slip off the table while being used, presenting a risk of impact injury	The person operating the generator should use one hand to hold the generator in place, or a clamp can be used to fix the generator to the table.	1	2	2
One version of the generator has had a metal cover removed to reveal it’s workings, potentially leaving sharp metal edges, which present a cutting risk	In adapting the generator the Ri will ensure sharp edges are filed down to remove the risk	1	1	1

Demonstration 7: Steam Turbine

Mini Turbine on the end of a pipe is placed in front of the steam output from domestic steamer, mounted on a retort stand, causing the turbine to spin

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y	Y	Y		

PPE Requirements

Item		Item		Item		Item	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection	Y		

Hazards and risks	Mitigation	Likelihood	Severity of Impact	Current Risk

Scalds to arm and hand from steamer	Turbine is held in the steam at a distance, on end of pipe. Presenter controls jet of steam. Presenter not to open reservoir until steamer is cool. Steamer turned off and placed in box between shows. Steamer not to be left unattended when switched on. Presenter controls steam output.	1	3	3
Risk of burns to face	Presenter has control of the steamer and is to be aware of where steam is produced. Never the less, eye protection should be worn when dealing with steam jets.	1	3	3
Electric shock	All electrical items are neither new or regularly PAT tested Items visually inspected before use.	1	3	3
Pressure explosion from steamer	Steamer is designed for high pressure with steam relief built in. Steamer inspected for damage before use. Ensure steamer is topped up with water before use.	1	4	4
Water spills causing slips	Paper Towels available in schools. Clear up any spills ASAP Presenter to monitor any volunteer movement around spills.	1	2	2

Demonstration 8: Wind Turbine

Wind turbine fitted to a hat is blown with Hairdryer/ leaf Blower by a young person or by presenter.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y	Y	Y		

Item		Item		Item		Item	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection	Y		

Hazards and risks	Mitigation	Likeli hood	Severity of Impact	Current Risk
Electric shock	All electrical items new or regularly PAT tested Items visually inspected before use.	1	3	3
Shards hitting volunteer in the eye	Volunteer wearing the hat will wear eye protection	1	4	4

Demonstration 9: Solar Panel Explainer

Method: The presenter selects 6 pupil volunteers and 1 teacher. The teacher is asked to stand on one side of the stage area and wear a “Sun” hat. They are also given some yellow foam balls. The pupils stand at the other side of the stage, in two rows of three (Row N and Row P). They are side on to the audience, and facing each other. There is a container of blue balls between the rows, and are given the following instructions:

SUN (Teacher)

- You will throw photons (the yellow balls) at Row N until you run out

N-TYPE SEMICONDUCTORS (Row N)

- You love electrons – you must always have one electron in your hand at all times. If you lose an electron, you must immediately pick one up from the bucket to replace the one you’ve lost. If you get hit anywhere on your body by a ball, you must give your electron to the person in front of you.

P-TYPE SEMICONDUCTORS

- You hate electrons – you must immediately get rid of any electron you are given by putting it in the bucket.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y	Y	Y		

PPE Requirements: None

Hazards and risks	Mitigation	Likelihood	Severity of Impact	Risk
Throwing objects at each other presents some risk of injury or damage.	Soft foam balls are used so injury is not possible. Presenter should think about positions of volunteers so balls don’t knock over any other equipment. Teacher is the only person actually throwing balls, so is trusted to act responsibly.	1	1	1
Balls could hit other objects (such as the hero engine), creating slip/trip hazards, risk of injury from broken glass, unwanted fires etc.	Position the pupils away from hazardous equipment (so hazardous equipment is not in the path of the balls being thrown by the teacher)	1	3	3

Demonstration 10: Dissolving Packing Chips

2 Volunteers are chosen. Each one is given a 500ml beaker and a spoon/stiring rod. Into one beaker is placed 4-6 biodegradable packing chips (Packing Peanuts). In the second is placed non biodegradable packing chips. The students put on safety spectacles. Water is added and the students are encouraged to stir the contents for 30 seconds. One set of chips will dissolve the other will not. Alternatively, all chips are put into 1 beaker with only 1 volunteer.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y	Y	Y		

Item		Item		Item		Item	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection			

Hazards and risks	Mitigation	Likelihood	Severity of Impact	Risk

Water in eye	Safety Spectacles to be worn when mixing. Water is fresh each show.	1	1	1
. Broken/ chipped glass	Beakers are strong lab quality. Beakers inspected for damage before use. Any broken glass is cleared up at the earliest opportunity	1	2	2
Water spills	Paper towels available in schools Clear up spills ASAP Presenter to monitor any volunteer movement around spills	1	1	1
Young person drinking contents of beaker	Volunteers are supervised during the show. Non biodegradable chips not left out between shows. Solution of starch chips and water is non-poisonous. Fresh water used for each show.	1	1	1

Demonstration 11: Hydrogen Balloon:

Aluminium Foil is dropped into a solution of Sodium Hydroxide (NaOH) producing Hydrogen. The gas bubbles through a cooling flask and inflates a pre stretched balloon attached to a hose.

The balloon is removed from the flask, tied, and fixed to a stand for the demonstration.

A volunteer is invited up, both presenter and volunteer issued with spectacles and ear defenders. The inflated balloon is then ignited using a candle on the end of an extending pole.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y		Y		

Item		Item		Item		Item	
Flameproof overalls		Gloves contact	Y	High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical	Y	Wellington boots	
Hearing protection	Y	Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection	Y		

Description of Hazard	Mitigation	likelihood	severity	risk
Exposure to Caustic Soda (Sodium Hydroxide) solid or solution.	Experienced presenter to be only person handling sodium hydroxide. Safety Spectacles to be worn. Nitrile gloves to be worn when handling. Water and cloths to clean up any spills. Place bung on top of reaction flask as soon as aluminium foil is placed into it. Funnel used to reduce spillage of granules. . Minimise movement of loaded flasks. Access to running water to wash any skin contamination. Sodium Hydroxide to be kept locked in box when not in use. Experienced presenter to be the only person handling sodium hydroxide	2	3	6
heat from Exothermic reaction of Sodium Hydroxide and Aluminium	If handling flask when hot use heat protective gloves. Wait for flask to cool to before moving with bare hands Minimal need to move flasks when warm.	2	1	2
Flask breaking due to heat reaction	Inspect flask for damage before use. Only use heat resistant glass from a reputable supplier. Allow glass to cool slowly when finished. Have access to dustpan and brush clean up.	1	3	3
Too much oxygen/air mixture in balloon.	Before use ensure balloon is fully deflated. Allow air to purge from flasks for 15 seconds before connecting balloon.	1	3	4
Unintended Ignition of hydrogen filled balloon	No naked flames while balloon is attached to the flasks. Ensure balloon is away from flasks on ignition. Candle only lit just before planned ignition. Ignition practices with volunteer. Presenter to control ignition pole by standing in front of volunteer and also holding the pole	1	3	3
Excess oxygen in balloon causing a very loud bang.	Purge air from flasks before attaching ball. All audience warned to cover ears. Volunteer and presenter to wear ear protection.	2	2	2
Flying rubber from balloon.	Volunteer/ presenter to wear safety spectacles when igniting balloons. Audience 3m away to allow for any balloon material to fall short or to lose all power	1	1	1

Ingestion of Sodium Hydroxide solution	NaOH is made immediately before use in show. Solution to be disposed of immediately after performance, poured down a non food sink and flushed down with fresh running water. Solution not to be left unattended at any time. After reaction has taken place it is no longer as corrosive, but move with bung on. Wash hands before eating/ drinking	1	6	6
Flash back from hydrogen in tube if accidentally ignited	Hydrogen is bubbled through water to reduce exposure to amount of hydrogen. Tube is moved away from ignition area before candle is lit. Hydrogen comes out of tube in short bursts so flash back possibility reduced.	1	4	4