Experimental Safety Plan.

Team Name: 10-Ohio-5 ---- TASK 5

Ohio University

An Experiment Safety Plan (ESP) is required for every experiment conducted and performed by students in the WERC Design Contest. The purpose of the ESP is to assure the safety of all by identifying the safest possible methods to conduct an experiment. By signing below the individual(s) conducting the experiment, College of Engineering Safety Specialist (COE Safety), and the faculty advisor acknowledge responsibility for the following requirements.

1) Appropriate Personal Protective Equipment (PPE) must always be worn while in the lab (as described in the ESP). The minimum required PPE to enter a research/teaching lab is (1) long pants, (2) closed toe shoes, (3) lab coat or long sleeve shirt, and (4) safety glasses with side shields.

2) For safety reasons, no researcher is permitted to work alone in the lab at any time. Because the labs are open24/7, there may be occasions (such as a late night or over weekends) when there are no other people working in the lab. If you plan to work during a time when the lab might be expected to be empty, please plan ahead and coordinate your work schedule with another lab member.

		Date
ESP Phase I approval: **COE Safety**		
ESP Phase II approval: **COE Safety**		

3) By signing below, both faculty advisor and researchers(s) understand that the CHO can approve/disapprove any part of the ESP. The CHO can further assemble a committee of individuals with appropriate technical or EH&S background to assist in reviewing the ESP. It is the goal of the CHO to help the researcher(s) find the safest method(s) of conducting an experiment. The CHO, or any faculty member, may stop lab activity of individuals not following good lab practices.

School and Team	**Name**	**Signature**	**Date**
Faculty Advisor	Darin Ridgway		
Researcher	Michael McMahon		
Researcher	Maggie Riley		
Researcher	Lain Weppler		
Researcher	Kyle Shermak		
Researcher	Connor Fallace		
Researcher	Owen Aliu		
Researcher	Kyle Carpenter		
Researcher	Ken Appell		
Researcher	Sherry Gabra		

Experimental Safety Plan.

Team Name: 10-Ohio-5 ---- TASK 5

Ohio University

An Experiment Safety Plan (ESP) is required for every experiment conducted and performed by students in the WERC Design Contest. The purpose of the ESP is to assure the safety of all by identifying the safest possible methods to conduct an experiment. By signing below the individual(s) conducting the experiment, College of Engineering Safety Specialist (COE Safety), and the faculty advisor acknowledge responsibility for the following requirements.

1) Appropriate Personal Protective Equipment (PPE) must always be worn while in the lab (as described in the ESP). The minimum required PPE to enter a research/teaching lab is (1) long pants, (2) closed toe shoes, (3) lab coat or long sleeve shirt, and (4) safety glasses with side shields.

2) For safety reasons, no researcher is permitted to work alone in the lab at any time. Because the labs are open24/7, there may be occasions (such as a late night or over weekends) when there are no other people working in the lab. If you plan to work during a time when the lab might be expected to be empty, please plan ahead and coordinate your work schedule with another lab member.

		Date
ESP Phase I approval: **COE Safety**		
ESP Phase II approval: **COE Safety**		

3) By signing below, both faculty advisor and researchers(s) understand that the CHO can approve/disapprove any part of the ESP. The CHO can further assemble a committee of individuals with appropriate technical or EH&S background to assist in reviewing the ESP. It is the goal of the CHO to help the researcher(s) find the safest method(s) of conducting an experiment. The CHO, or any faculty member, may stop lab activity of individuals not following good lab practices.

EH & S(at request of COE Safety)			

Required attachments to the ESP:

Attachment 1: Experimental Scope
Attachment 2: Drawing of Experimental Layout including P&ID
Attachment 3: Normal Operation, Startup and Shut-down Procedures
Attachment 4: Emergency Shutdown Procedures
Attachment 5: Waste Management Procedure
Attachment 6: Hazard Identification and Mitigation
Attachment 7: Other Equipment and Chemical Needs
Attachment 8: Safety Data Sheets

Experimental Safety Plan

Experimental Scope

Provide a concise description of the benchscale laboratory experiment to be undertaken.

Experiment Summary

Explain how and why the work is being performed, the goal(s) of the experimental program

Content:

An experiment has been designed that will purify the water stream given by the competition to the drinking water standards of New Mexico while removing rare earth elements (REEs). The water will go through a system of graphite and stainless-steel electrodes, which will be used to precipitate REEs. The suspended solids will be captured by a series of filters before entering a distillation column, which will further purify the remaining water into a wastewater product and drinkable product.

Safety Admin Comment:

Safety Item Details:

Balanced Chemical Reaction(s)

If a chemical reaction is occurring, intentionally, then provide the stoichiometry of any chemical reactions and their heats of reaction. If no intentional chemical reactions, then list this as "Not Applicable"

Content:

Uploaded in attached file

Safety Admin Comment:

Safety Item Details:

Thermal Safety of Chemical Reaction(s)

If a chemical reaction is occurring intentionally, then calculate the inherent thermal safety of your experiment. A guide for calculating this can be found at the following site: https://chme.nmsu.edu/research/ehs/experimental-safety-plan-esp/esp-energetics-calculation/)**If no intentional chemical reactions then list this as Not Applicable**

Content:

Uploaded in attached PDF

Safety Admin Comment:

Safety Item Details:

List of All Chemicals, Materials and Equipment

Include a complete list of all chemicals and materials involved in this experiment. Include household chemicals such as bleach, vinegar, ammonia, table salt, baking soda etc. If you are using glue, silicone, paint etc. be sure to include those. Materials used for construction of your experiment such as wood, PVC pipe, metal or plastic tubing, insulation etc. need to be listed here. Equipment list must include items such as pumps, heat baths, stirring mechanisms, filters, reservoirs, centrifuge, solar panels, computers, antennas, meters, sensors, etc.

Content:

List of chemicals provided in 18 L solution:

- 3.6 g Humic Acid (provided in solution)
- 2286 g NaCl (provided in solution)
- 27.9 g $MgCl_2$ (provided in solution)
- 9 g KCl (provided in solution)
- 469.8 g Na_2SiO_3 (provided in solution)
- 27 g Na_2SO_4 (provided in solution)
- 32.4 g $CaCO_3$ (provided in solution)
- 2.7 g $FeCl_3$ (provided in solution)
- 18 mg $NdCl_3$ (provided in solution)
- 18 mg $LaCl_3$ (provided in solution)
- 18 mg $EuCl_3$ (provided in solution)

List of Equipment for Experiment:

- Graphite electrodes
- Stainless Steel electrodes
- Solids paper filters
- Polyethylene tubing
- 3 110 V batteries
- Distillation column
- Glass microfiber filters
- 1 Pump

Safety Admin Comment:

Safety Item Details:

Tethering of liquid hoses

Describe how you plan to tether or secure liquid hoses from pumps and pressure equipment or list “none”.

Content:

hose clamps

Safety Admin Comment:

Safety Item Details:

Experiment Timeline

Include a timeline for this experiment including setup, sample runtime(s) and teardown. Explain any requests for after-hours running of experiments, including if equipment needs to be monitored by someone onsite, or list "none"

Content:

Setup: Approximately one hour

Sample run-time: The electrolysis system will run for 30 minutes per cation, so 2.5 hours total. The distillation will run for approximately 30 minutes.

Tear-down: Approximately one hour

Safety Admin Comment:

Safety Item Details:

Drawing of Experimental Layout including P&ID

Provide a detailed drawing of the experiment as a flow diagram that shows all inputs and outputs for equipment and system. This is required for all ESPs regardless of complexity and something basic is acceptable.

Drawing of Experimental Layout including P&ID

Content:

Safety Admin Comment:

Safety Item Details:

Normal Operation, Startup and Shut-down Procedures

PPE Required

Include a statement of the required PPE at the beginning of the procedure, and at every location in the procedure where the PPE requirements change (For example, if gloves are required for certain steps of your experiment.)Include a statement of the required PPE at the beginning of the procedure, and at every location in the procedure where the

PPE requirements change (For example, if gloves are required for certain steps of your experiment.)

Content:

gloves

safety glasses

lab coat

long pants

Safety Admin Comment:

Safety Item Details:

Stepwise Procedure

Provide a step-wise procedure that describes in detail how the work will be performed. The procedure should begin and end with the equipment in the normal idle (inoperative) state.

Content:

Safety Admin Comment:

Safety Item Details:

Run time and/or run rate and description

Include details of how you will meet the required elements of your chosen task (e.g. run time, run rate, sample rate etc.) as required in your task or list “none”

Content:

See attached file.

Safety Admin Comment:

Safety Item Details:

Hazardous Material Handling

Describe how hazardous chemicals to be transported to the event or list “none”. Describe how hazardous materials will be stored at the event and used in the benchscale experiment or list “none”

Content:

none

Safety Admin Comment:

Safety Item Details:

Emergency Shutdown Procedures

Provide a step-wise procedure that describes how the equipment will be brought to a safe state in the event of an emergency. Consider emergency situations such as loss of power, fire in your equipment, fire in the surrounding lab area, etc. The description should include a detailed explanation of how to attend to potential medical emergencies that may result

Emergency Shutdown Procedure

Provide a step-wise procedure that describes how the equipment will be brought to a safe state in the event of an emergency such as. loss of power, fire in your equipment, fire in the surrounding benchscale lab area, etc.

Content:

Normal 0 false false false EN-US X-NONE X-NONE /* Style Definitions */ table.MsoNormalTable {mso-style-name:"Table Normal"; mso-tstyle-rowband-size:0; mso-tstyle-colband-size:0; mso-style-noshow:yes; mso-style-priority:99; mso-style-parent:""; mso-padding-alt:0in 5.4pt 0in 5.4pt; mso-para-margin:0in; mso-para-margin-bottom:.0001pt; mso-pagination:widow-orphan; font-size:12.0pt; font-family:"Calibri",sans-serif; mso-ascii-font-family:Calibri; mso-ascii-theme-font:minor-latin; mso-hansi-font-family:Calibri; mso-hansi-theme-font:minor-latin; mso-bidi-font-family:"Times New Roman"; mso-bidi-theme-font:minor-bidi;}

In the case of emergency:

1) Cut off power supply to cathodes and anodes

a. Remove clamps on mesh and plates, be sure not to short circuit in hazardous surroundings

2) Cut off power supply to pump

a. Unplug pump and remove from hazardous surroundings

Safety Admin Comment:

Safety Item Details:

First Aid

The description should include a detailed explanation of how to attend to potential medical emergencies (e.g. first aid) that may result

Content:

In case of lesions or burns, provide first aid from provided kit. All other potential medical emergencies, seek medical attention/call an ambulance.

Safety Admin Comment:

Safety Item Details:

Waste Management Procedure

Waste Description(s)

Describe all waste materials that to be generated in performing these experiments or list "none". Note that NMSU will provide containers and forms required by the researcher for proper disposal of materials.

Content:

There will be no waste generated within the bench-scale process, we do plan on re-dissolving all solids back into the 5 gallon solution that will be provided.

Safety Admin Comment:

Safety Item Details:

Waste Volume(s)

Describe the estimated volume of each waste material generated or list "none".

Content:

Provided water: 5 gallon

Safety Admin Comment:

Safety Item Details:

Waste State(s)

Describe state of each waste material generated (e.g. solid, liquid, slurry, etc.) or list "none".

Content:

The state of waste material will be in a liquid phase, with the potential of a slurry to be present if the the solids cannot be re-dissolved.

Safety Admin Comment:

Safety Item Details:

Waste Segregation(s)

Describe the waste(s) compatibility and needs for segregation (i.e. what cannot be mixed with what) or list "none".

Content:

None

Safety Admin Comment:

Safety Item Details:

Hazard Identification and Mitigation

Identify and discuss ALL HIGH hazards associated with the experiment. Fill out the WERC Benchscale Lab Hazard Assessment Checklist.

The analysis must consider

- **all sources of energy (electric, chemical, hydraulics, mechanical, compressed gases),**
- **extreme conditions of pressure or temperature (from flame or steam to cryogenics),**
- **chemical use and storage,**
- **housekeeping,**
- **fire potential**
- **biological hazards**
- **light and sound frequency and level**

Items marked Yes

Describe how you will ensure safety from any item marked "yes" on the checklist or list "none"

Content:

5 gallons of water will be used at the bench-scale level

Safety Admin Comment:

Safety Item Details:

Working with gas under pressure, in gas cylinders or as part of experimental conditions : False
Working with water volume in excess of 1 gallon : True
Working with corrosive Liquids : False
Working with organic solvents or flammable chemicals: False
Working with acutely toxic , carcinogenic or highly hazardous chemicals: False
Working with air or water reactive chemicals : False
Working with engineered nanomaterials such as carbon nanotubes, silver wire, carbon fiber etc. or other dusts with particle sizes Working with potentially explosive chemicals : False
Working with temperaturs 100C : False
Working with radioactive compounds : False
Working with Class 3 or Class 4 Lasers : False
Working with Biological Materials classified as BSL-3 or lower : False
Working with cryogenic materials including dry ice : False
Working with liquids >100C including from sources such as oil bath, water bath, pressure vessel, autoclave etc.) : False
Working with open flames : False
Working with loud equipment (>85 db) : False
Working with a centrifuge : False
Working with a sonicator : False
Working with sharp objects such as needles, knives, razor blades etc. : False
Working with machine hazards such as pinch points, caught by or stuck by dangers etc. : False
Working with electrical hazards such as un-insulated wiring, exposed control panels, wet conditions, etc. : False
Working with electrical voltage in excess of 110V : False
Working with batteries, all types such as lead-acid, nickel-cadmium, lithium etc. : False
Working with high center of gravity hazards such as tall apparatus that requires extra support etc. : False

Additional Hazards

Describe any other hazards not shown on the checklist such as biological, energy etc. and how you plan to ensure safety from them or list "none"

Content:

none

Safety Admin Comment:

Safety Item Details:

Additional PPE

Describe additional PPE you feel is required beyond Safety Glasses, Close Toe Shoes, and Long Pants or list "none"

Content:

none

Safety Admin Comment:

Safety Item Details:

Training and Protocols

Describe any special training or protocols you feel are required to work or be present in your benchscale lab area. An example might be special UV safety glasses. If nothing applies then list "none"

Content:

none

Safety Admin Comment:

Safety Item Details:

Other Equipment and Chemical Needs

Provide a list and details of any equipment you require that will not, or cannot, be shipped to the event. We have several items available for use and can make them available, but you have to tell us what you need. Examples include balances, electrical test meters, hand tools, secondary containment vessels (e.g. kiddie wading pool), easels, stands, brackets, clamps etc.

Special Equipment Needs

Describe any requests for equipment to borrow at the event or list "none"

Content:

none

Safety Admin Comment:

Safety Item Details:

Special Chemical Needs

Describe any requests for specialized chemicals that cannot be shipped. This of this nature include liquid nitrogen, dry ice and gas cylinders.

Content:

none

Safety Admin Comment:

Safety Item Details:

Secondary Containment

Describe how you plan to provide secondary containment for all liquids in your process.

You may request one of our "kiddie wading pools" here and you will be notified if your team will receive one since we have a limited number available.

List "none" if no liquids will be generated by your experiments.

Content:

none

Safety Admin Comment:

Safety Item Details:

Safety Data Sheets

Provide SDS documents for all chemicals used at the event including household and consumer products

Attach a Safety Data Sheet document in pdf format for each chemical or material in your experiment including household chemicals, glue, paint, etc

Safety Data Sheets

Content:

PDF documents for all chemicals used within our bench-scale design are uploaded

Safety Admin Comment:

Safety Item Details: