2020 Experimental Safety Plan (ESP) Instructions

**General Instructions**

*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 benchscale lab area.* ***The minimum required PPE 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 one is permitted to work alone in the benchscale lab area at any time.*
3. *ESP approval occurs in two phases.*
   1. *Phase I is the preparation of a written safety plan and includes an evaluation by COE Safety (and if appropriate by EH&S) to establish controls of hazardous operations, avoid the purchase of inappropriate supplies, and establish expected waste(s) streams. Upon approval of the written plan, the team may bring their experiments, equipment and necessary chemicals to the WERC Design Contest. This Phase I step may take up to 2 weeks for reviews, comments, corrections and final approval.*
   2. *Phase II approval will occur onsite at the event and requires evaluation of the assembled experiment. Upon approval, the team will receive their synthetic water solution(s) or other task related materials and can begin operation of their experiments.*

**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*
* *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”*
* *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/*](https://chme.nmsu.edu/research/ehs/experimental-safety-plan-esp/esp-energetics-calculation/) *)*
  + *If no intentional chemical reactions then list this as Not Applicable*
* *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.*
* *Tethering of liquid hoses* 
  + *Describe how you plan to tether or secure liquid hoses from pumps and pressure equipment or list “none”.*
* *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”*

**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.*

**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.)
* *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.*
* *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”*
* *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”*

***E*mergency Shutdown Procedures:**

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

**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.*
* *Waste Volume(s)*
  + - *Describe the estimated volume of each waste material generated or list “none”.*
* *Waste State(s)*
  + - *Describe state of each waste material generated (e.g. solid, liquid, slurry, etc.) or list “none”.*
* *Waste Segregation(s)*
* *Describe the waste(s) compatibility and needs for segregation (i.e. what cannot be mixed with what) or list “none”.*

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**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*
* *WERC Lab Hazard Assessment Checklist*
* *(Insert questions with yes/no answers from checklist in this box)*
* *Items marked Yes*
* *Describe how you will ensure safety from any item marked “yes” on the checklist or list “none”*
* 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”
* Additional PPE
  + Describe additional PPE you feel is required beyond Safety Glasses, Close Toe Shoes, and Long Pants or list “none”
* 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”.

***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”*
* *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.*
* *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.*

***Safety Data Sheets***

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

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