West Virginia University Environmental Health and Safety office (EHS) has created a resource enhancement initiative to both reduce costs and provide improved environmental stewardship, while complying with the Resource Conservation and Recovery Act (RCRA). One of the most concerning and potentially expensive wastes to manage are our potential peroxide forming, time sensitive, and/or otherwise highly reactive hazardous wastes inside of our laboratories which are each their own satellite accumulation areas (SAA). These wastes commonly consist of unused products of diethyl ether, picric acid, sodium azide, tetrahydrofuran, 1,4-dioxane, and others that have exceeded their recommended expiration date or have been stored in improper conditions. Due to the fact they are expired, unusable, and/or potentially unstable, they are considered waste. These wastes require special attention pre-transport to be safely handled until final disposal to avoid shock sensitivity, mitigate peroxide development, and/or reduce the instability potential.

Multiple hazard prevention and management methods have been attempted from 2010 to 2016. Approximately every four to six months, EHS had to bring reactive material specialists to our campus for a few containers. WVU had 34 RCRA sites and no treatment, storage, and disposal facility. Prior to 2010, EHS managed these chemicals only after a request was submitted to have waste removed. From 2010 to 2013, notes were made during laboratory audits and waste service pickups as to what labs were using these chemicals. This was just a notation that was never compiled into a single document or converted to usable data. In 2014 EHS attempted to remove any expired chemicals that could pose a threat over time. During waste service pickups, researchers were asked if they needed the chemicals. If they did, they were advised of the hazards and were left. If they did not, EHS removed them without the requirement of submitting a disposal request. This still left many expired chemicals with potentially reactive properties in the labs.

Finally, in 2015 EHS began a full audit specifically looking for these potential peroxide forming, time sensitive, and/or otherwise highly reactive chemicals. Recorded information including location, name, quantity, and expiration date was compiled into a master list. All containers were labeled “Caution: Time Sensitive” and applicable information on proper testing and storage requirements was provided. Any chemicals that were expired at that time were removed as hazardous waste. In 2015, EHS completed 3 stabilization and disposal events of over 160 individual containers at 5 independent sites at a cost of $13000.

With education on the proper management of the chemicals, EHS believed we could avoid having reactive materials specialists return to campus; however, in 2016, EHS spent an additional $8400 due to mishandling or laboratory closures that produced more of these reactive wastes. The last of the events was November 2016 when the cost was over $1900 to stabilize a single container. Another solution was necessary.

Our initial goal was to reduce the number of times these specialists had to come to the university by at least 1 time. At worst case, we only wanted the specialists to be onsite twice a year. With that goal in mind, and a reduction in cost viewed to be $1900 per container, a $2000 to $2500 budget to accomplish this was set.

The major hazards from these containers consist of shock sensitivity during handling, friction based reactivity from opening screw lids with peroxide crystals present, and contamination from metal or other instruments due to oxides. To address researcher exposure or safety concerns, a need for hazard control existed. Annual training was the first change, with a much higher emphasis on proper documentation of handling and testing of these chemicals. After much debate about administrative restrictions on purchasing, EHS was left with one option being reasonably acceptable and achievable.

EHS decided to begin leaving these chemicals, which are now hazardous wastes, inside the labs where they were generated. For compliance with RCRA, waste generated inside a SAA may remain there until fifty-five gallons are generated with no time limitation. Nearly all of the SAA at WVU could conduct months of research before this limit would normally be reached. Previously, acting on safety concerns, chemicals were moved to EHS's secure CAA. This move began a 90 or 270 day countdown to be shipped offsite and for the reactive specialists to arrive on campus. Leaving the wastes in SAA, thereby increasing the time limit, is where our major savings could be realized.

EHS also considered the safety need aspects; therefore, engineering and administrative controls to protect researchers were evaluated. After some initial engineering controls were evaluated, EHS decided on an explosives day box to be the base of the engineering control. Some problem areas arose from this decision with regards to regulations, facility requirements, and space restrictions.

First, these boxes could not be locked by EHS as this would be a violation to RCRA because it is not "under the control of the operator" in a SAA. A pin thru the hasp with a serial-numbered seal would allow easy opening, but stop most curious researchers from doing so. Second, explosive day boxes could not be anchored to the wall or floor due to holes being left in the finished flooring or wallboard upon removal. This was remedied using a cable lock around closed-loop furniture legs or facility conduit or piping. Third, most commercial, non-custom boxes are made to be low and wide. Our chemical containers are usually tall and thin. We found a commercially available box that met the size requirements to hold up to a standard 4 liter bottle, but was still small enough to fit into most lab areas. This required us to make the boxes able to be placed on their side. Bottom plates were constructed and adhered to the original side of the box to provide a stable base, without compromising the original box itself. Lastly, the wooden interior of the aluminum clad explosives day box did not prevent smaller containers from toppling over inside. Packing material was added that could be placed around internal containers to prevent movement.

Since we used a commercially available, stock sized box, the costs were kept reasonable at $380 each. The base, pins, and seals for each box cost about $14. To capture as many of these containers as possible before having to collect all wastes for final disposal, we ended up purchasing 5 boxes with accessories at a total of $1968. This cost was less than the cost of the single container requiring stabilization in November 2016. This now allows for up to five reactive wastes requiring stabilization to be accumulated safely in SAA. Once a sixth container is encountered, it, along with the 5 in accumulation, will be collected and placed into the CAA. When this occurs, only then will our 90 or 270 day countdown begin.

As of March 2018, no reactive specialist services have been required since the boxes are now utilized. In fact, all five boxes are now in use at one of our small quantity generator sites, in five different SAA. When the next item is encountered, we will remove all the other boxes from the SAA and put the wastes into our CAA. This will cause the start of our 270 day countdown to have the reactive specialists on site. If the sixth item is at a large quantity generator site, we will take one of the now-available boxes to that site to utilize in SAA. If the item is at a small or very small quantity generator, we will simply take the sixth item to our CAA. While we still require a visit from the reactive specialists, this will be our first event since November 2016. (It would also be at least 270 days from the date of the sixth item being encountered, likely well into 2019.) We accomplished our goal and exceeded expectations to go over two years without reactive specialists onsite, perhaps longer.

Supplemental Information:

Reactive Stabilization Costs	
Year	**Cost**
2012	$37,750
2013	$6,426
2014	$7,784
2015	$13,226
2016	$8,461
Acquisition Costs (Boxes and Accessories)	$1,968
2017	$0
2018	$0
2019 (Estimate for all accumulated items)	$1,575