United States Tax Court

T.C. Memo. 2023-84

MARK BETZ AND CHRISTINE BETZ,
Petitioners

v.

COMMISSIONER OF INTERNAL REVENUE,
Respondent

DENNIS LINCOLN AND JULIA LINCOLN,
Petitioners

v.

COMMISSIONER OF INTERNAL REVENUE,
Respondent

Docket Nos. 21587-18, 21588-18. Filed July 6, 2023.

Ps in these consolidated cases are shareholders in C, an S corporation that designs and supplies air pollution control systems. As of 2014, C had extensive institutional knowledge and experience in supplying systems that met the specifications of customers in manufacturing industries. On its 2014 information return, C claimed a research credit under I.R.C. § 41 in connection with 19 projects. C claimed the research credit in connection with both the costs of producing the systems it supplied and the wages it paid to certain of its employees for activities performed in connection with the projects. C did not use a time-tracking system for its employees' activities and thus estimated the amounts of employee time spent performing qualified services. On their personal federal income tax returns for 2014, Ps claimed a flowthrough of the credit and later carried forward the remaining portion of the credit to their 2015 and 2016 returns.

Served 07/06/23

[*2] *Held*: For all 19 projects, Ps failed to carry their burden of establishing that the products were pilot models. Accordingly, C's purported qualified research expenditures (QREs) for costs of production failed to satisfy I.R.C. § 41(d)(1)(A) and were not creditable.

Held, further, for all 19 projects, Ps failed to carry their burden of establishing that the wages of certain of C's employees were incurred in connection with the performance of qualified services. Accordingly, C's purported QREs for wages were not creditable.

Held, further, for five of the projects, C did not retain substantial rights in the results of its research under its applicable contracts with its customers. Accordingly, C's purported QREs for those five projects were incurred in connection with funded research within the meaning of I.R.C. § 41(d)(4)(H) and were not creditable.

Held, further, Ps are liable for accuracy-related penalties under I.R.C. § 6662(a) for tax years 2014, 2015, and 2016.

John H. Dies, *Jeffrey E. Falvey*, *Jeremy M. Fingeret*, *Jefferson H. Read*, and *Matthew S. Reddington*, for petitioners.

Jonathan E. Behrens, *Frederic J. Fernandez*, *Eugene A. Kornel*, and *Richard L. Wooldridge*, for respondent.

MEMORANDUM FINDINGS OF FACT AND OPINION

NEGA, *Judge*: These cases involve a section 41[1] research credit claimed by an S corporation engaged in the business of designing and supplying air pollution control systems that eliminate harmful airborne manufacturing byproducts. The issues for decision are (1) whether

[1] Unless otherwise indicated, statutory references are to the Internal Revenue Code, Title 26 U.S.C., in effect at all relevant times, regulation references are to the Code of Federal Regulations, Title 26 (Treas. Reg.), in effect at all relevant times, and Rule references are to the Tax Court Rules of Practice and Procedure.

[*3] petitioners, the groups of which include the sole shareholders of the S corporation, are entitled to a research credit of $501,531 for tax year 2014 and (2) whether petitioners are liable for accuracy-related penalties for tax years 2014, 2015, and 2016. We hold for respondent on both issues.

FINDINGS OF FACT

Some of the facts have been stipulated and are so found. The Stipulations of Facts and the attached Exhibits are incorporated herein by this reference. Petitioners resided in Illinois when they timely filed their Petitions.

I. *Catalytic Products International, Inc.*

Catalytic Products International, Inc. (CPI), was founded in 1969 by Erwin Betz. In 2014 CPI was a subchapter S corporation, with the shares owned equally (50%) by Erwin Betz's children, petitioner Mark Betz (Mr. Betz) and petitioner Julia Lincoln (Ms. Lincoln). As of January 2, 2014, CPI's board of directors comprised Mr. Betz, Ms. Lincoln, petitioner Dennis Lincoln, and Matthew Lincoln. In 2014 CPI used an accrual method of tax accounting.

Beginning in 1987, when Mr. Betz joined the company, CPI transitioned its business away from manufacturing catalysts for installation in air pollution control systems, instead becoming a designer and supplier of custom-built air pollution control systems, primarily catalytic and thermal oxidizers.

II. *Oxidizer Basics*

In 2014 CPI supplied both catalytic and thermal oxidizers, which each eliminate certain environmentally hazardous airborne manufacturing byproducts. We will refer to these byproducts as volatile organic compounds (VOCs) as a convenient shorthand.[2] Catalytic oxidizers are designed to convert VOCs into carbon dioxide and water vapor via a process of chemical reaction between the VOCs and a

[2] Our use of the term may not necessarily reflect whether the byproducts discussed herein are VOCs within the technical meaning of regulations issued by the Environmental Protection Agency (EPA). *See* 40 C.F.R. § 51.100(s) (2023).

[*4] catalyst.[3] Thermal oxidizers are designed to achieve the same result but do so by using a burner to generate extremely high heat to incinerate VOCs, rather than using a catalytic conversion process. There are three separate subtypes of thermal oxidizers: (1) direct/straight, (2) recuperative, and (3) regenerative.

A direct/straight thermal oxidizer uses a simplistic burner to heat a combustion chamber; process air containing VOCs passes through the system and oxidizes when encountering the high temperatures. A recuperative thermal oxidizer adds to the concept by using a stainless-steel heat exchanger to preheat process air, which provides for increased energy efficiency.[4] This heat exchanger usually consists of a shell and tube structure that operates by intaking clean, postcombustion air into an exterior shell that transfers heat to interior tubes carrying the process air. A regenerative thermal oxidizer instead uses a heat exchanger comprising ceramic media beds, which retain heat at an even higher rate and thus allow for increased energy efficiency. Regenerative thermal oxidizers operate by intaking process air through the media, then reversing the postcombustion air back through the media, thus retaining the heat. Because of their energy efficiency, the issue of overtemperature, where the system's temperature rises too high and degrades the heat exchanger, is a particular problem for regenerative thermal oxidizers. Designs of regenerative thermal oxidizers typically use a hot gas bypass, which diverts high temperature air out of the system in order to reduce temperature. As of 2014, regenerative thermal oxidizers were the most common type of oxidizer used in manufacturing industries.

A few general considerations go into the choice of a type of oxidizer system and its basic design. One consideration is the aforementioned energy efficiency: Oxidizers can use considerable volumes of natural gas in operating the burners that heat the air. For cost-conscious customers, an oxidizer with reduced volume or performance but increased thermal efficiency (i.e., where high

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[3] A catalyst is a substance that triggers a chemical reaction but is not itself consumed in that chemical reaction. A common example is the catalytic converter in an automobile, which converts the VOCs present in the exhaust into carbon dioxide and water.

[4] To illustrate the concept, heat exchangers are typically used as part of the heating process in residential gas furnaces. Furnaces use a burner to generate hot gas within a heat exchanger chamber; cold air then encounters the now-heated outer walls of the heat exchanger and becomes hotter before being distributed throughout the residence.

[*5] temperature is maintained without significant use of fuel-consuming burners) might be optimal. Another basic consideration is the concentration and type of VOCs generated by the customer's manufacturing process; for certain VOCs, a catalytic reaction is less effective than a thermal one or would degrade the catalyst over time. Certain types of VOCs may also require a higher operating temperature or residence time to oxidize, which would affect the sizing of components and increase upfront costs.

Another consideration is whether the customer's manufacturing process airflow contains other particulates or chemicals that could affect the oxidizer's performance. For instance, if the process airflow contained silicone, oxidization would generate silicone dioxide (i.e., sand), which could accumulate and plug an oxidizer. Finally, the location and layout of a customer's manufacturing process plays a role. Space constraints at the facility may dictate the choice and sizing of various components, while extreme temperatures or heavy winds may require additional insulation or structural support features for outdoor components.

III. *CPI's General Process*

In 2014 CPI's business model was as follows. First, CPI would either solicit or be contacted by a prospective customer. If unfamiliar with the customer, CPI personnel would sometimes visit the customer's facility to review their manufacturing process and measure what VOCs were being generated. Customers would often provide CPI with the necessary specifications about the process airflow at the customer's facility, such as the volume of process airflow, the type of VOCs generated, and the airflow temperature. If the customer was unable to provide specifications, CPI personnel or a third party would sometimes test and measure the airflow at a jobsite.

CPI personnel considered an oxidizer's design to be largely dictated by three basic considerations: (1) the necessary level of destruction efficiency; (2) the process air flow volume; and (3) the particular VOCs generated.[5] Once this information was available, CPI personnel would begin assembling a project proposal. CPI personnel would input the particular VOCs and airflow volumes at issue into a computer spreadsheet (known internally at CPI as Bessy), which would

[5] Destruction efficiency is the percentage of the VOC concentration in the process air that is destroyed by the oxidizer.

[*6] then output calculations breaking down how the VOCs would oxidize, including the lower explosive limit (LEL) and heat value of the airflow exhaust.[6] Based on the particular VOCs at issue and the airflow volume, CPI personnel would then calculate the necessary sizes of the various components, such as burners and fans, by using standardized spreadsheets or performing simple hand calculations.

Next, the now-sized components would be incorporated into a general arrangement design drawing and a process and instrument diagram (P&ID).[7] On the basis of the prepared drawings, CPI personnel would solicit bids from subcontractors about the potential cost of assembly. With an estimated cost of assembly in hand and the size of the components preliminarily calculated, CPI personnel would come up with a quoted price for the customer and assemble a project proposal. In the project proposal, CPI would recommend a particular type of oxidizer based on the applicable characteristics of the process airflow and describe its various components and features. Generally, the initial project proposal provided by CPI to the customer was not the final version. Customers often requested changes to the proposal, such as increases in the guaranteed efficiency of the oxidizer, additional guarantees or warranties, or revisions to terms and conditions.

Once a final proposal was accepted by a customer and purchase and sale orders exchanged, additional design drawings would be prepared, reviewed, and completed for various components of the oxidizer. The project would then be passed on to a project manager, who would begin issuing purchase orders to suppliers (for various components of the oxidizer) and to subcontractors (for fabrication and assembly). CPI maintained ongoing relationships with a number of suppliers and subcontractors. CPI would engage a subcontractor, typically PRE-Heat, Inc., to fabricate the physical structure of the system, which was generally composed of heavy, welded steel, and to assemble the components of the system. CPI would purchase components from suppliers, who would then directly provide those

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[6] LEL indicates the lowest concentration of an airborne compound that is capable of exploding in the presence of an open ignition source. If an airflow is measured at a high percentage of LEL, that airflow is at greater risk of igniting; National Fire Prevention Association standards generally dictate that a number above 25% of LEL is an unsafe level.

[7] A general arrangement drawing portrays the physical structure of the assembled oxidizer, while a P&ID details how airflow, gas, and electrical signals interact with components of the system.

[*7] components to the fabricating subcontractor to be assembled as part of the oxidizer. For the exhaust stack, CPI would usually engage a separate subcontractor, typically IVI North, Inc., to fabricate the stack. On some projects, the subcontractor would take on greater design responsibility. For instance, PRE-Heat would typically handle the design for heat exchangers, inputting data from the particular facility into a proprietary program in order to determine the appropriate sizing.

CPI personnel would also begin designing the electrical control system of the oxidizer. Using the P&ID drawing, CPI engineers would create an electrical schematic drawing for the control panel, showing the placement of the various inputs and outputs into the system and the requisite horsepower. Finally, CPI engineers would program a sequence of operations into the control system to automate its various functions. CPI would engage a subcontractor, typically Quantum Design, Inc., to build the control system panel and enclosure for the oxidizer.

While fabrication was ongoing, CPI personnel would sometimes conduct quality control inspections on the work of the fabricating and electrical subcontractors, to ensure that the fabrication conformed to CPI's design drawings. Sometimes revisions would be made to an oxidizer's design over the course of a project in response to feedback from either a subcontractor or the customer. Once an oxidizer was completed, CPI personnel would typically oversee assembly of a system at the fabrication subcontractor's facility; the oxidizer would then be freight shipped to the customer's facility. At the customer's facility, CPI would either install the system itself or have personnel present to supervise the installation. After physical installation, CPI startup personnel would spend time at the facility, programming the control system and conducting further quality testing to ensure that components conformed to CPI's design drawings and operated without issues. Finally, a third party would generally conduct testing on the oxidizer for purposes of compliance with environmental regulations. On some occasions, a tested oxidizer would perform below the destruction efficiency guarantee made by CPI, which would contractually require CPI to make additional repairs or modifications to the oxidizer.

IV. *The Alliantgroup Study*

Alliantgroup L.P. is a tax consultancy and lobbying firm which, inter alia, maintains a research credit group that specializes in promoting section 41 credits and assisting taxpayers with all stages of claiming the credit. On February 20, 2015, Ms. Lincoln executed an

[*8] engagement letter for Alliantgroup to conduct an R&D tax credit study for CPI and to provide audit defense. The engagement letter stated that Alliantgroup would bill at a blended hourly rate of $375; the billed fees were capped so as not to exceed 25% of the combined state and net federal research credits identified by Alliantgroup. Initially, Alliantgroup requested from CPI a list of employees with job details, job costing reports, Forms W–2, Wage and Tax Statement, and payroll records for 2010 through 2013, and CPI's federal and state tax returns for 2010 through 2013. On April 2, 2015, an Alliantgroup representative emailed Ms. Lincoln a list of CPI projects that they wished to discuss during an upcoming site visit to CPI; the list comprised 18 projects.[8]

On April 8, 2015, Alliantgroup personnel visited CPI's facility; during the visit, Alliantgroup personnel interviewed Messrs. Betz and Harmsen and Ms. Lincoln. On April 9, 2015, Alliantgroup personnel emailed Mr. Harmsen and Ms. Lincoln a spreadsheet based on their discussions, which purported to allocate certain percentages of the 2014 wages paid to CPI's employees to 19 CPI projects. The interviews with Messrs. Betz and Harmsen were the source of the underlying allocation percentages in the spreadsheet. In 2014 CPI did not have a system that tracked employee time. On April 10, 2015, an Alliantgroup employee emailed to Ms. Lincoln a pro forma Form 6765, Credit for Increasing Research Activities, with calculations for a potential research credit for CPI. The pro forma Form 6765 listed $1,983,647 as the amount of wages for qualified services and $5,732,211 for the cost of supplies, which amounted to a gross credit of $771,586 and a net credit of $501,531.

On October 26, 2015, an Alliantgroup employee provided Ms. Lincoln with a project summary report for the research credit study, which concluded that CPI was qualified to claim a section 41 credit.[9] On December 10, 2015, Mr. Betz and Ms. Lincoln signed a copy of the completed study, under a field entitled "Employees Verifying Information." In the study, Alliantgroup identified 19 projects with associated qualified research expenditures. The completed study again stated that CPI had paid or incurred $1,983,647 in qualifying wage expenditures and $5,732,211 in qualifying supply expenditures, for a total of $7,715,858 of QREs. With respect to wage expenditures, the completed study stated that Alliantgroup had allocated percentages of

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[8] The DuPont La Porte project, for which qualifying research expenditures (QREs) were eventually claimed, was not listed in this email.

[9] As we discuss in further detail below, both CPI and petitioners had timely filed their respective tax returns for tax year 2014 in April 2015.

[*9] CPI's employees' wages paid or incurred for qualified services as follows:[10]

Employee Name	*2014 R&D %*	*Tax Year 2014 Salaries*	*Tax Year 2014 QREs*
G.B.	80%	$55,424	$55,424
Betz, Mark	80%	823,231	823,231
F.C.	80%	49,022	49,022
C.D.	83%	69,328	69,328
S.F.	82%	39,172	39,172
Harmsen, Scott	88%	179,302	179,302
C.H.	63%	104,297	65,707
R.J.	80%	80,863	80,863
C.J.	60%	15,209	9,125
E.M.	82%	48,050	48,050
B.O.	60%	58,000	34,800
J.O.	90%	21,038	21,038
Shaver, Robert	80%	341,534	341,534
L.S.	90%	20,706	20,706
T.S.	60%	40,186	24,112
R.T.	80%	40,992	40,992
B.W.	50%	39,038	19,519
J.Y.	90%	24,466	24,466
T.Z.	86%	37,255	37,255
Total	**n/a**	**$2,087,113**	**$1,983,647**[11]

For 17 of the employees, Alliantgroup allocated percentages of wages to particular projects; the wage QREs of those 17 employees totaled $818,882 (i.e., roughly 41% of the claimed wage QRE total).

[10] For brevity's sake, we exclude from the table the CPI employees that Alliantgroup determined performed no qualified services in 2014. Aside from petitioner Mr. Betz and Messrs. Harmsen and Shaver, both of whom testified at trial, we will use initials to refer to particular CPI employees.

[11] The wage QREs identified by Alliantgroup in fact amount to a total of $1,983,646; we can safely attribute the one-dollar discrepancy from the listed amount to rounding error.

[*10] Alliantgroup purported to allocate the wages of two employees, Messrs. Betz and Shaver, evenly across all 19 projects; the wage QREs of Messrs. Betz and Shaver totaled $1,164,765 (i.e., roughly 59% of the claimed wage QRE total).

With respect to supply QREs, Alliantgroup personnel reviewed CPI's internal accounting records for each project. With respect to the base period, Alliantgroup personnel interviewed Mr. Betz and Ms. Lincoln and reviewed accounting statements from 1984, 1985, 1986, and 1987 in order to determine whether CPI had gross receipts and QREs for those tax years. Alliantgroup ultimately calculated a fixed base percentage of 3.02% and average annual gross receipts of $23,782,532. Using those calculations, Alliantgroup again concluded in the study that CPI was entitled to a research credit of $771,586, calculated without an election under section 280C.

V. *CPI Employees*

In the study, Alliantgroup determined that 19 CPI employees performed qualified services. We provide brief job descriptions for each of those employees.

A. *Mr. Betz*

In 2014 petitioner Mark Betz was the vice president of engineering for CPI. Mr. Betz's primary responsibilities were wide ranging and included both working with customers on the sales side and doing application engineering.

B. *Mr. Shaver*

In 2014 Robert (Scott) Shaver was the vice president of sales for CPI. Mr. Shaver's primary responsibilities included heading up the sales team, soliciting customers, and being involved at the outset in CPI's chemical application engineering. Mr. Shaver left his employment with CPI sometime in 2016.

C. *Mr. Harmsen*

In 2014 Scott Harmsen was the director of engineering for CPI. Mr. Harmsen's primary responsibility was supervising the engineering, drafting, and processing personnel at CPI, as well as being lead chemical application engineer. Sometime after 2014 Mr. Harmsen was promoted

[*11] to president of CPI and remained in that position as of the dates of trial in these cases.

D. *R.J.*

In 2014 R.J. was a senior electrical engineer for CPI. R.J.'s primary responsibility was designing the electrical systems and programming the control systems for CPI's oxidizer systems.

E. *C.D.*

In 2014 C.D. was an electrical designer for CPI. C.D.'s primary responsibility was largely identical to R.J.'s and involved designing the electrical controls and programming the control systems for CPI's oxidizer systems.

F. *S.F.*

In 2014 S.F. was a design detailer for CPI. S.F.'s responsibilities included creating and modifying design drawings and making guidelines for CPI's systems.

G. *T.Z.*

In 2014 T.Z. was an engineering manager for CPI. T.Z.'s primary responsibilities consisted of reviewing all the design drawings, supervising the draftsmen, and managing the schedule and construction by the fabrication subcontractors.

H. *L.S.*

In 2014 L.S. was a fabrication specialist for CPI. L.S.'s responsibilities consisted of overseeing and coordinating with the third-party fabricators, which included soliciting bids, reviewing design drawings, and conducting quality audits.

I. *Messrs. G.B. & R.T.*

In 2014 G.B. and R.T. were each draftsmen for CPI. G.B. was generally responsible for installation design, including preparing ductwork, steel, and location drawings. R.T. was generally responsible for drawing designs, project management, and sourcing components from suppliers.

[*12] J. *Messrs. F.C., E.M., J.O., & J.Y.*

In 2014 F.C., E.M., J.O., and J.Y. were each project managers for CPI. All four of these individuals' primary responsibilities were interacting with the customer, reviewing and approving drawings and calculations, and ensuring delivery of an oxidizer to the customer's facility. J.O. left his employment with CPI during 2014.

K. *Messrs. C.H., C.J., B.O., T.S., and B.W.*

In 2014 C.H., C.J., B.O., T.S., and B.W. were each sales engineers (i.e., salespeople) for CPI. Their responsibilities included putting together initial calculations in proposals delivered to customers and generally soliciting new customers.

VI. *The Projects at Issue*

A. *3M Hutchinson (#13-07520)*

During the years at issue 3M Company (3M) and CPI had an ongoing commercial relationship, which was reflected in a Master Equipment Supply & Services Agreement (master agreement), effective August 4, 2010. Clause 8.3 of the master agreement provided that

> Seller may create drawings, illustrations, instructions, maintenance information, and other materials that relate to the Equipment, and if Seller retains ownership of any such materials, then Seller grants 3M the perpetual, unrestricted right to use, copy, and distribute those materials for 3M's internal use.

Clause 10.2 provided that CPI "maintains all of its proprietary rights related to its products and manufacturing processes, including all product components and pre-existing product designs." Clause 10.2 next stated that

> 3M owns all tangible and intellectual property rights in any goods, equipment (including the Equipment), apparatus, documents, drawings, computer software and artwork which 3M provides to Seller, Seller creates at 3M's

[*13] expense, or Seller creates using 3M Confidential Information ("3M Rights").[12]

Clause 10.2 continued, stating in relevant part that with respect "to any property subject to 3M Rights, Seller: (a) hereby assigns to 3M or its designated affiliate all of Seller's rights, including, without limitation, all intellectual and tangible property rights and (b) will deliver that property to 3M when Seller has finished using it to fulfill Order(s) under the Agreement." Finally, clause 12 provided that "[a]ny claim or dispute arising from or relating to the Equipment or the Agreement will be: (a) governed by the laws of the State of Minnesota . . . without regard to its conflict of laws provisions." The terms of the master agreement governed all of CPI's projects for 3M, including 3M Hutchinson.

During the years at issue 3M manufactured sticky notes at a facility in Hutchinson, Minnesota. Before engaging CPI, 3M had used an aging regenerative thermal oxidizer at the Hutchinson facility, which it had determined to replace. As part of the bidding process on the project, on June 25, 2013, 3M provided CPI with an extensive and detailed list of required specifications for a 30,000 standard cubic feet per minute (SCFM) regenerative thermal oxidizer. The specifications provided for a 99% destruction efficiency. The specifications provided measurements for the minimum and maximum airflow volume and solvent rate at the facility and identified the VOC emissions as "a combination of methanol, ethyl acetate, IPA, toluene, and other common solvents."

The 3M Hutchinson project was the first regenerative thermal oxidizer designed by CPI.[13] However, Mr. Harmsen was experienced in working with regenerative thermal oxidizers from prior employment, and he handled the applications engineering on the project. 3M recommended particular suppliers to use for the various components of the oxidizer; for a number of other components, 3M also provided specific brands and sizes to be included. Mr. Harmsen generally considered the specifications to be typical. Several of the specifications required by 3M

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[12] Clause 10.1 separately defined "3M Confidential Information" as including "all Orders placed by 3M, 3M Materials, 3M Equipment, the terms of the Agreement, the Parties' relationship, and any other information about how 3M makes or sells products or conducts its business."

[13] Before the 3M Hutchinson project, CPI supplied regenerative thermal oxidizers to customers but engaged other engineers to design them.

[*14] were atypical for CPI, such as using two burners instead of one, including manual lifts in the system, and providing for a control enclosure that could contain a desk. The specifications also stated that 3M was "concerned with residue build-up on the forced draft fan wheel or other internal parts" and provided two options—an induced draft process fan with a mixing box or a forced draft process fan with a preheat system—to address this concern in the design.[14]

In July 2013 after questions by other parties bidding on the project, 3M issued a revised set of specifications. CPI then provided 3M with an initial proposal for an oxidizer system; after reviewing CPI's proposal, 3M requested that several more clarifications and revisions be incorporated into the design. In August 2013 CPI submitted a revised proposal for a regenerative thermal oxidizer, which 3M accepted. The proposal included additional technical specifications for various components of the oxidizer. The proposal also included a 99% destruction efficiency performance guarantee. In September 2013 3M and CPI exchanged purchase and sale orders. The final payment terms were a total price of $1,135,840. CPI then engaged IVI North to fabricate and supply an exhaust stack for the system and engaged PRE-Heat to fabricate and supply the oxidizer system.

In late October 2013 G.B. completed an initial general arrangement drawing and an initial P&ID drawing for the oxidizer. In December 2013 C.D. completed initial electrical schematic diagrams for a control panel. CPI engaged Quantum Design to fabricate a main and remote control panel and enclosure for the oxidizer and Lantec to supply a ceramic heat exchanger. In December 2013 CPI issued a purchase order to AirPro Fan & Blower Co. (AirPro) for a 300 horsepower booster fan, described as arrangement 3B; AirPro then submitted design drawings for a booster fan to CPI for approval, which were in turn approved by 3M's engineering department. In April 2014, after reviewing CPI's electrical schematic drawings, 3M's electrical engineers discovered some discrepancies from the voltage provided for in the specifications. CPI then issued a change order to Quantum Design for some revisions to the control panel.

In April 2014 S.F. completed a general arrangement drawing for the oxidizer system, which was checked by J.Y. By the time S.F.

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[14] The difference between the two types of fans is a simple one: Induced draft fans provide negative pressure (i.e., pull) while forced draft fans provide positive pressure (i.e., push).

[*15] completed the general arrangement drawing, minor changes had already been incorporated into the drawing in prior revisions made in both 2013 and 2014. Those changes included (1) adding an additional walkway to the front of the system for accessing the gas trains; (2) adding davit cranes to the front of the system in order to lift components; and (3) reworking the design of the gas trains.

Ultimately, CPI installed the system at the Hutchinson facility, with Mr. Harmsen and F.C. on site to supervise the installation. In January 2015 testing was performed on the system under actual process conditions at the Hutchinson facility. The testing demonstrated that the system was not satisfying the destruction efficiency performance guarantee. Eventually, CPI discovered a gap under a poppet valve, which it resolved by welding a ring into place to eliminate the gap. In May 2015 3M informed Mr. Harmsen that the oxidizer had been measured as satisfying 99%+ destruction efficiency.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

[*16]

Component	*Cost*
Barometric damper	$4,025
Booster fan (moved VFD sales est to electrical)	89,971
Burner	11,178
Ceramic media	43,862
Combustion air piping	9,451
Combustion blower	4,455
Component location	1,624
Control house	44,995
Ductwork	3,441
Electrical loose parts	5,767
Electrical panel (sales est includes VFD from BF)	91,955
Exhaust stack	50,370
Gas piping	24,461
Gas train	40,619
Hotside bypass damper	15,451
Internal assembly combustion chamber	13,995
Internally insulated ductwork	14,500
Mechanical loose parts	1,156
Total	**$471,275**

[*17] B. *Akzo Nobel (#13-07645)*

During the years at issue Akzo Nobel Coatings, Inc. (Akzo Nobel), manufactured industrial paint at a facility in Huron, Ohio. At the facility, Akzo Nobel used reactors and tanks for mixing paint, which emitted some limited VOC byproducts such as xylene, a paint dilutant. For 30 years Akzo Nobel had used a direct thermal oxidizer to destroy VOCs. In 2013 Akzo Nobel put out a request for bids on a new oxidizer, to which CPI responded. CPI personnel visited the Huron facility, met with Akzo Nobel personnel, and learned the specifications for the project. CPI personnel then entered the specifications into a spreadsheet, which output a potential size of 8,000 SCFM; ultimately, CPI determined that the size would be 6,000 SCFM. J.O. was the project manager, while Mr. Harmsen was the applications engineer for the project.

In December 2013 CPI provided a proposal to Akzo Nobel for a regenerative thermal oxidizer, sized at 6,000 SCFM and with 95% thermal efficiency. The proposal included a 98% destruction efficiency performance guarantee. Akzo Nobel responded by sending to CPI a confirmation of purchase order for the supply and installation of a regenerative thermal oxidizer, for a total price of $271,000. CPI then engaged Lantec to fabricate and supply multilayer ceramic media and PRE-Heat to fabricate and supply the oxidizer system and various components. Akzo Nobel and CPI personnel conducted a joint hazard study of the oxidizer to assist Akzo Nobel personnel in learning the equipment and understanding the safety protocols involved in operating the oxidizer. As a result of the hazards study, CPI made some minimal changes to the design of the electrical control system.

In January 2014 R.J. prepared electrical schematic drawings for the oxidizer's control panel. On February 7, 2014, Mr. Harmsen and J.O. visited the Huron facility to meet with Akzo Nobel personnel. At the meeting, Mr. Harmsen took notes on various potential issues and sketched out a basic diagram of what the oxidizer would look like. In his notes, Mr. Harmsen identified several potential issues, including how fire suppression would be tied into the system and how to design the ductwork and new dampers. CPI determined to include in the design a flame arrestor, a component that would prevent flame transmission.[15] CPI personnel later entered specifications into a

[15] A flame arrestor is a failsafe component that impedes airflow and thus essentially prevents a potential explosion from continuing past the arrestor's location.

[*18] supplier's sizing program, which output the potential model and size for a flame arrestor component. Given the basic requirements of the system, J.O. and other CPI personnel calculated the appropriate size for various other components, including a media bed, burners, and a fresh air damper.

CPI engaged MK Systems, Inc., to design and supply a booster fan for the oxidizer. CPI engaged Quantum Design for the fabrication of a control panel enclosure for the oxidizer, to be based on CPI's drawing set. On February 26, 2014, R.T. visited PRE-Heat's facility to inspect the fabrication of the oxidizer; in a checklist, R.T. signed off on a number of different elements of the oxidizer and noted that other elements were still work-in-progress.

On March 13, 2014, R.T. visited PRE-Heat's facility to inspect the fabrication. In March 2014 R.T. prepared a general arrangement drawing for the oxidizer, which was checked by Mr. Harmsen. This drawing incorporated revisions stemming from CPI's having determined what booster fan and combustion blower would be included in the system. R.T. subsequently revised the general arrangement drawing of the oxidizer in order to change the customer connection and to add a handrail and access ladder, respectively, in response to a request from Akzo Nobel.

Akzo Nobel performed the installation of the oxidizer at the Huron facility, with CPI personnel supervising. In September 2014 a third party performed emissions testing on the oxidizer and determined that oxidizer's destruction efficiency was on average 97.93%, just below the 98% performance guarantee provided by CPI. As part of its warranty, CPI sent service technicians to the facility to potentially make adjustments. Ultimately, CPI resolved the issue by conducting its own testing and measuring that the parts per million (PPM) of methane in the exhaust was only 1.41—well below the alternate efficiency guarantee of 25 ppm from CPI's proposal.[16]

As part of the research credit study, Alliantgroup also calculated that the following supply costs were qualified research expenditures:

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[16] This was likely due to the low sample size of VOCs at issue, which made it difficult to reach 98% at a given point because of the measuring issues.

[*19]

Component	*Cost*
Engineering add-ons	$2,086
Booster fan	8,564
Burner	1,822
Ceramic media	4,410
Combustion air piping	1,194
Combustion blower	3,681
Ductwork	78
Electrical boxes	1,296
Electrical loose parts	16,212
Electrical panel	39,906
Exhaust stack	14,634
External assembly combustion chamber	90,240
Fresh air damper	2,994
Gas train	7,502
Internal assembly combustion chamber	10,088
Mechanical loose parts	1,186
Total	**$205,894**

C. *HA International (#13-07615)*

During the years at issue HA International, LLC (HAI), maintained a manufacturing plant in Oregon, Illinois. At the plant, HAI produced frac sand, a chemically infused sand that is used by the natural gas industry in the process of hydraulic fracturing (known more familiarly as fracking). A number of hazardous chemicals, including

[*20] phenolic resins, furfuryl alcohol, hexamine, and ammonia, were injected into the sand in order to make it useful for fracking purposes.

HAI contacted CPI about potentially designing two oxidizers, as HAI's scrubber equipment at the time was ineffective and had led to an enforcement issue with the EPA. C.J. was staffed as the sales engineer on the project. In early 2013 CPI employees did initial emissions testing at HAI's plant. CPI employees tested the air exhaust of the plant and observed HAI's manufacturing process. In an emissions study, dated April 18, 2013, CPI concluded that HAI's current scrubber equipment was failing to achieve the required 98%+ efficiency and that the jobsite had a number of issues, including a lack of proper ventilation and the buildup on equipment surfaces of resin containing VOCs. The emissions study also measured a number of different VOCs present in the process airflow, including formaldehyde, phenol, and methanol.

CPI personnel determined that recuperative thermal oxidizers would be more appropriate than catalytic ones because of the loose sand generated by HAI's manufacturing process, which could degrade a catalyst, and HAI's use of chemical compounds that were less susceptible to catalytic conversion. CPI personnel determined that recuperative thermal oxidizers would allow the loose sand to accumulate in the bottom of the machine (where it could later be cleaned out) without interfering with performance, whereas other oxidizers would be negatively affected by the sand. Considering the VOCs present, CPI personnel also determined that airflow's percentage of LEL, as measured, was sufficiently high that the airflow into the oxidizer should be diluted. Accordingly, CPI included in the design a fresh air dilution valve, a fresh air damper, and a safety system to guard against the risk of explosion. In order to accommodate the existing water scrubber, CPI included a duct heating system that would evaporate any water vapor from the scrubber.

In November 2013 CPI delivered to HAI a revised proposal for the design of two 13,700 SCFM recuperative thermal oxidizers with 99% VOC destruction efficiency, with C.J. listed as the sales engineer. The proposal included the assumed VOC characteristics and levels of the process airflow. The proposal stated, inter alia, that the basis of CPI's recommendation was "its experience gained through +30 units in the sand resin coating industry." The referenced "+30 units" that CPI had previously designed were oxidizers installed for customers using resin-coated sand to coat automotive components. The proposal also discussed several of the relevant design characteristics. In relevant part, the

[*21] proposal stated that CPI proposed "to preheat the exhaust gases from the scrubber prior to entering the ductwork," in order to "elevate the saturated air stream well above the condensate threshold to help reduce both water and resin buildup prior to the pollution control equipment." Accordingly, the proposal also stated that CPI would supply a direct fired duct heater system designed to heat the water vapor from the scrubber exhaust. Finally, the proposal included a 99% VOC destruction efficiency performance guarantee.

Also in November 2013 HAI issued a purchase order to CPI for the oxidizer, with attached terms and conditions and a total price of $1,898,750. Clause 14 of the terms and conditions, entitled "Intellectual Property Rights," stated as follows:

> HA is entitled to all documents, drawings, specifications, calculations and other information carriers with respect to the performance of the activities of Contractor under the Order. HA will be solely entitled to all intellectual property rights (including patents) created during the performance of the obligations under the Order. In case the intellectual property rights are with both Contractor and HA, Contractor will assure and guarantee that HA has a full license to use these without any conditions for an indefinite period of time.

Clause 20 of the terms and conditions stated that the terms would "be construed in accordance with the laws of the State of Ohio without application of its conflict of laws provisions." On November 18, 2013, CPI issued to HAI a sales order for the oxidizer.

In early January 2014 G.B. completed an initial general arrangement drawing for the oxidizer. R.J. completed a P&ID drawing for the oxidizer as well as electrical schematic drawings for a control panel. CPI engaged PRE-Heat to fabricate and assemble the thermal oxidizer and other components and Quantum Design to fabricate two control enclosures. On April 17, 2014, Quantum Design issued to CPI a project scope change form, noting several changes, including an increased enclosure size in order to accommodate an air conditioner.

After fabrication was completed, the oxidizer parts were shipped to HAI's facility for installation. In June and July 2014 R.J. and another CPI employee conducted quality inspections on the oxidizer's electrical systems and oversaw startup.

[*22] After installation, testing of the oxidizer revealed another issue in which several tubes in the heat exchanger overheated because of inadequate airflow. CPI resolved the issue by replacing and rewelding the tubes and then replacing the baffles installed with a different air splitting component, in order to achieve better airflow uniformity. Testing of the oxidizer also revealed that vibration within the oxidizer had ruptured some pressure release valves. CPI resolved the issue by cutting down the length of the damper blades, which were causing the excess vibration.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

[*23]

Component	*Cost*
Booster fan	$45,330
Burner	10,378
Combustion air piping	11,883
Combustion blower	3,914
Duct heater	44,986
Electrical panel	39,960
Exhaust stack	18,690
Gas train	30,443
Heat exchanger	283,951
Internal assembly combustion chamber	44,952
Mechanical loose parts	861
Seal air blower	1,833
Seal air blower piping	633
Total	**$537,813**

D. *3M Hartford (#13-07611)*

During the years at issue, 3M manufactured different types of tape at a facility in Hartford City, Indiana. 3M initially contacted CPI to assist in replacing a failing heat exchanger in one of their existing thermal recuperative oxidizers. The production process at the Hartford facility emitted VOC byproducts such as heptanes and hexanes. These VOCs were attached to silicone molecules, which presented an issue, as oxidizing the VOCs would trigger the formation of silicone dioxide (i.e., sand) that needed to be cleaned out of the oxidizer. Upon examination of the existing oxidizer, CPI personnel determined that the system was beyond the point of failure and recommended that 3M replace it. C.H. was the sales engineer on the project.

[*24] As with the Hutchinson project, 3M provided extensive specifications and required criteria for a potential oxidizer, including the maximum exhaust temperature, type of VOCs at issue, and required destruction efficiency. CPI personnel considered the process airflow volume specification provided by 3M to be lower than the minimum airflow needed for the oxidizer. Accordingly, CPI personnel determined to include in the design a recirculation duct that would recycle cleaned air from the exhaust stack back to the process inlet to achieve the necessary minimum airflow.

In November 2013 CPI submitted a proposal to 3M for a recuperative thermal oxidizer, which it described as a Quadrant SRS-Silicone Series. The proposal included the process airflow characteristics, as provided by 3M, such as the VOCs at issue and the range of concentrations. The proposal stated, in relevant part, that the proposal was based on the system's "ability to offer assured destruction without worry about Silicone plugging while offering the lowest maintenance costs and highest uptime reliability." The proposal also stated that the system was "designed to minimize the effects of SiO_2 build up for fast and efficient cleanout," by including ports to "accommodate future inspections and cleaning" out of the SiO_2 particulate. The proposal included a standardized page discussing the problem of silicone dioxide and stating that the Quadrant SRS Silicone Series thermal oxidizer had been developed "to provide an economical answer to the disastrous effects of SiO_2." CPI had developed the Quadrant SRS Silicone Series over a period of years and considered it to be a unique, proprietary technology that it could market to the specific industry of manufacturers using silicone coating. Also in November 2013 CPI issued a sales order to 3M for the thermal oxidizer, for a total price of $1,569,700. The terms of the master agreement governed CPI's contract with 3M on the Hartford project.

CPI personnel, including Mr. Betz, ran a number of calculations as to the sizing of components, such as the combustion blower and the burners. In December 2013 G.B. completed an initial general arrangement drawing for the oxidizer, which was checked by J.Y. In February 2014 R.J. completed a P&ID drawing for the oxidizer. CPI engaged PRE-Heat for the fabrication and supply of the recuperative oxidizer system and components. In April 2014 R.J. completed control enclosure schematic drawings for the oxidizer. CPI engaged Quantum Design for the fabrication of control panel enclosures for the oxidizer, based on CPI's drawing set.

[*25] In June 2014 3M provided CPI with revised information about the process airflow volume, which allowed CPI personnel to make the recirculation duct component smaller. Also in June 2014 Mr. Harmsen contacted a 3M representative to provide notice of a scope change; 3M personnel had become concerned that the sand particulate would affect the booster fan, so CPI proposed to change to a radial blade fan that could handle the particulate. Also in June 2014 CPI personnel visited PRE-Heat to inspect the progress on the fabrication, at which point the oxidizer was nearly finished. After installation at the Hartford City facility, the oxidizer passed third-party compliance testing.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

[*26]

Component	*Cost*
Booster fan	$49,746
Burner	23,226
Combustion air piping	615
Ductwork	521
Electrical loose parts	2,047
Electrical panel	64,452
External assembly combustion chamber	10,002
Field assembly	10,239
Gas train	45,880
Heat exchanger	43,710
Hot side bypass damper	19,539
Seal air blower	9,864
Barometric relief damper	4,392
Total	**$284,233**

E. *C&D Zodiac (#13-07583)*

During the years at issue, Zodiac Aerospace Composites & Engineered Materials (C&D Zodiac) manufactured composites for commercial aircraft at a facility in Marysville, Washington. C&D Zodiac's manufacturing process generated VOC byproducts such as phenol and formaldehyde. In 2013 Messrs. Betz and Harmsen visited the Marysville facility to measure flow rates and then delivered to C&D Zodiac an engineering study stating that their existing oxidizer had insufficient volume. Before submitting a proposal to C&D Zodiac, Mr. Harmsen input the measured values into a spreadsheet, which output the potential BTUs per pound and pounds per hour of potential VOCs in the process airflow, which would in turn determine the necessary size of

[*27] the oxidizer. Using various process airflow measurements, Mr. Harmsen determined that the oxidizer size would be smaller than he had anticipated and thus would allow for a more efficient heat exchanger and avoid the need for a hot gas bypass. C.H. was the sales engineer on the project.

In October 2013 CPI submitted a proposal for a 9,400 SCFM regenerative thermal oxidizer. The proposal described the VOC levels and characteristics of the process airflow. The proposal also included a 98% destruction efficiency performance guarantee. Also in October 2013 CPI issued a sales order to C&D Zodiac for the thermal oxidizer, for a total price of $374,500. On November 4, 2013, the CPI project team, which included Messrs. Betz, Harmsen, J.O., and C.H., held an internal kickoff meeting to discuss the project and particular elements of the oxidizer design. At the meeting, Mr. Harmsen discussed the inclusion of a duct heater in the design, in order to heat the process air to an extent sufficient to avoid buildup of resin condensation in the ducts.

CPI engaged Quantum Design to fabricate and supply a control panel enclosure for the oxidizer. In late November 2013 J.O. exchanged emails with David Foster, the project manager at C&D Zodiac, regarding minor changes to the design drawings. At J.O.'s request, Mr. Foster provided the earthquake rating for the Marysville area, which had to be accounted for in the design of the exhaust stack. In late November 2013 J.O. prepared an initial general arrangement drawing and a P&ID drawing for the oxidizer and emailed them to Mr. Foster for approval. After reviewing the drawing set, Mr. Foster informed J.O. that the P&ID drawing's placement of the Marysville facility's print room was inaccurate and should be updated. In December 2013 the P&ID drawing was revised per C&D Zodiac's comments.

CPI engaged Lantec to fabricate and supply multilayer ceramic media, PRE-Heat to fabricate and supply a regenerative thermal oxidizer and various components, and IVI North to fabricate and supply an exhaust stack. In December 2013 C.D. completed initial electrical schematic drawings for a control panel. On February 16, 2014, R.T. visited PRE-Heat to inspect the oxidizer and media assembly and poppet valve housing. On February 26 and March 13, 2014, R.T. again visited PRE-Heat to inspect various components in the fabrication process.

In March 2014 R.J. provided Quantum Design with updated electrical schematic drawings to be revised in order to comply with third-party certification standards. CPI engaged Quantum Design to have its

[*28] technicians travel to PRE-Heat's facility and make additional revisions to the control system to meet certification standards. During installation at the Marysville facility, CPI discovered that the control panel enclosure door was too close to the booster fan; CPI moved the control panel enclosure over to resolve the issue.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

[*29]

Component	*Cost*
Booster fan	$22,668
Burner	2,165
Ceramic media	13,200
Combustion air piping	1,693
Combustion blower	3,418
Electrical boxes	1,298
Electrical loose parts	1,317
Electrical panel	68,456
Exhaust stack	19,835
External assembly combustion chamber	6,202
Field assembly	163
Fresh air damper	3,134
Gas train	7,059
Internal assembly combustion chamber	18,595
Engineering add-ons	1,781
Total	**$170,984**

F. *Teva (#14-07808)*

During the years at issue, Teva Pharmaceuticals USA (Teva) operated a pharmaceutical facility in Salt Lake City, Utah. In 2014 Teva was in the process of installing a new manufacturing line that required pollution control, pursuant to EPA standards. The primary VOC byproduct of Teva's manufacturing process was ethanol.

CPI was invited to bid on the project and determined that a catalytic oxidizer would be optimal. CPI personnel reached this

[*30] determination partly because of the limited space at Teva's facility. Teva also provided CPI with specifications about the characteristics of the airflow exhaust at the Salt Lake City facility. In April 2014 CPI submitted a proposal for a catalytic oxidizer, described as a Vector series. The proposal included extensive specifications and a performance guarantee that total VOC concentration would be reduced by at least 98%. The proposal also stated that the system would include a self-cleaning ceramic guard bed; after discussions with Teva, CPI had determined that the guard bed would be necessary to protect the catalyst from other particulates in the facility's airflow. T.S. was the sales engineer on the project.

In May 2014 Teva and CPI exchanged purchase and sale orders for the catalytic oxidizer, for a total price of $217,600. The purchase order attached Teva's standard terms and conditions; clause 14 provided that CPI would "not use, sell, loan or publicize any of the tools, specifications, blueprints, designs or artwork supplied or paid for by Buyer for the fulfillment of this order without Buyer's written consent." Similarly, clause 15 provided that "[a]ll tools, dies, molds, printing plates, mechanical, etc. created for use on this order shall be the property of Buyer, and Buyer may withdraw them from Sellers's premises on demand in writing."

CPI personnel calculated the size of components, such as the catalyst bed chamber, the exhaust stack, and the burners, using the information about the process airflow provided by Teva. CPI engaged PRE-Heat for the fabrication and assembly of a heat exchanger, exhaust stack, and various other components. In June 2014 C.D. completed electrical schematic drawings for a control panel enclosure. Subsequently, CPI engaged Quantum Design to fabricate and supply a control panel and enclosure based on CPI's drawings. From June to October 2014 CPI purchased a number of physical components and materials from vendors, with shipping typically made to PRE-Heat.

PRE-Heat completed fabrication and assembly of the oxidizer, at which point CPI personnel visited its facility to conduct "a final quality audit." The quality audit included dye penetrant testing of the oxidizer body and testing of the control system. The oxidizer was then shipped to Teva's facility in Salt Lake City. Teva personnel installed the oxidizer at the Salt Lake City facility, with CPI personnel present to supervise. After installation, the oxidizer's heat exchanger was preheating too high. CPI resolved this issue by modifying the control system in order to introduce additional fresh air into the process to bring down the

[*31] temperature via a damper on the inlet side of the system fan. The system later passed its third-party compliance testing.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

Component	*Cost*
Booster fan	$8,959
Burner	1,960
Catalyst – 8800 = ECO#1 3000	11,880
Combustion air piping	1,170
Combustion blower	1,441
Electrical panel	25,626
Exhaust stack	1,141
Fresh air damper	2,744
Gas train	8,323
Heat exchanger	56,666
I Asbly combustion chamber 15500 = ECO#1 500	6,200
PIT Sitrans	963
Tee damper	3,107
Total	**$130,178**

G. *Mitsubishi (#14-07899)*

During the years at issue. Mitsubishi Electric Automotive America, LLC (Mitsubishi), operated a facility in Mason, Ohio, that manufactured motor starters and other engine components for engine suppliers. Mitsubishi's manufacturing process generated the chemical styrene as a VOC byproduct. Mitsubishi's existing 12,000 SCFM catalytic oxidizer system had been supplied by CPI 14 years earlier. The

[*32] catalytic oxidizer had been experiencing a buildup of condensates in recent years, creating a maintenance problem and reducing the system's capacity to approximately 10,000 SCFM. Mitsubishi requested that CPI provide suggestions for a larger (either 35,000 or 25,000 SCFCM), more efficient, and maintenance-friendly oxidizer, as it planned to expand the Mason facility. Using the two potential airflow volumes, Mr. Harmsen performed simple calculations for the potential size of several components.

In July 2014 CPI submitted a revised proposal for either a 35,000 or a 25,000 SCFM regenerative thermal oxidizer. The proposal described the process airflow as "styrene with a heat content of approximately 17,000 BTU/lb." The proposal also included a 98% destruction efficiency performance guarantee. In August 2014 Mitsubishi sent CPI a purchase order for the 35,000 SCFM oxidizer, for a total price of $675,750. Mr. Betz prepared a P&ID drawing for the oxidizer that was based on CPI's existing knowledge of the Mitsubishi facility and Mitsubishi's expansion plans. C.D. completed initial electrical schematic drawings for a control panel. S.F. completed an initial general arrangement drawing for the oxidizer.

CPI engaged Lantec to fabricate and supply multilayer ceramic media, Quantum Design to fabricate and supply the control panel enclosure of the oxidizer, and both Global Fab and PRE-Heat to fabricate and supply various components of the oxidizer. CPI engaged a general contractor located near Mitsubishi to perform the installation of the system at the facility, under the supervision of Messrs. Harmsen and E.M.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

[*33]

Component	*Cost*
Booster fan	$31,537
Burner	44,333
Ceramic media	47,880
Combustion air piping & weather hood	2,710
Combustion blower	3,484
Electrical loose parts	2,112
Electrical panel – SEE EXCEL for details	31,067
Exhaust stack	21,870
Fresh air damper	4,142
Gas train	11,500
Mechanical loose parts	3,328
BF outlet exp jnt	967
BF VFD NEMA 1 250HP w/disconnect	15,543
Engineering add-ons	4,484
Ex stack exp jnt	1,377
Poppet valve assemblies	26,849
Total	**$253,183**

H. *3M Monrovia (#14-07784)*

During the years at issue 3M manufactured silicone rubber gasketing for the aerospace industry at a facility in Monrovia, California. Before engaging CPI, 3M used an existing recuperative thermal oxidizer supplied years earlier by a different oxidizer contractor. As of 2013 that oxidizer was no longer meeting California environmental regulatory standards. In February 2013 3M provided

[*34] CPI with an extensive and detailed list of required specifications for a 12,000 SCFM recuperative thermal oxidizer. The specifications included the requirements that the oxidizer "include design features necessary for cleaning of SiO2 dust from the heat exchanger and combustion chamber". The specifications also provided information about the process airflow, including minimum and maximum airflow rates, temperatures, solvent rates, and the VOC at issue (toluene).

In April 2014 CPI submitted a revised proposal, which 3M accepted via a purchase order, for a total price of $1,277,400. The final proposal stated that CPI would supply 3M with a silicone recuperative oxidizer from CPI's Quadrant SRS product line. The proposal also included a 99% destruction efficiency performance guarantee. CPI also provided 3M with general arrangement and P&ID drawings for the oxidizer. The terms of the master agreement governed CPI's contract with 3M on the Monrovia project. Mr. Harmsen was the lead applications engineer on the project and assisted with project management.

3M had informed CPI personnel that the oxidizer would need to meet California state law requirements with respect to its emissions. In particular, the specifications provided by 3M noted the requirement for low nitrogen oxide-emitting burners. In May 2014 G.B. completed an initial general arrangement drawing for the oxidizer, which was checked by F.C. In June 2014 CPI personnel input the provided specifications into a spreadsheet, which output a possible size for the burner. CPI also submitted its design drawings to a third party, Larson Engineering, Inc. (Larson), for review; Larson reviewed the drawings for the purpose of determining whether they complied with California requirements with respect to seismic activity. Also in June 2014 Larson issued a report certifying the drawings as acceptable. Similarly, CPI submitted the design drawings to a different third-party engineer who performed calculations and made suggestions as to how the stack could comply with California requirements. In July 2014 R.J. prepared electrical schematic drawings for the oxidizer. Ultimately, after consulting with Maxon Corp., CPI's typical burner supplier, CPI personnel included a low emissions burner in the design. In August 2014 CPI submitted to 3M several design drawings, including the general arrangement drawing, for approval.

CPI engaged IVI North to fabricate and supply an exhaust stack, PRE-Heat to fabricate and supply the oxidizer and various components, and Quantum Design to modify the existing control panel enclosure and

[*35] fabricate a new control panel. In July 2014 R.J. completed electrical schematic drawings for a control panel enclosure. In September 2014 CPI and 3M conducted a joint process hazard analysis (PHA), to review the design drawings and relevant possible safety issues at the Monrovia facility. Mr. Harmsen and F.C. participated on CPI's side. As a result of the PHA, CPI made several design changes to the design drawings.

In February and March 2015 CPI submitted to 3M additional revised design drawings for approval. After assembly was completed, the oxidizer was installed at the Monrovia facility by a third-party contractor, under the supervision of F.C. At some point after installation, an inspection of the oxidizer by 3M found that the cone installed around the burners was cracking and failing; pursuant to the contractual warranty, CPI repaired the problem.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

[*36]

Component	*Cost*
Barometric relief damper	$8,011
Burner	7,565
Combustion air blower	7,777
Combustion air piping	38,183
Control house	33,866
Davit arm	2,724
Ductwork	5,425
Electrical panel	54,920
Exhaust stack	62,068
Field assembly	12,927
Filter box	14,996
Filter box dampers	21,649
Gas train	30,690
Hardware & gasket	1,988
Heat exchanger	352,290
Process booster fan	50,352
Seal air blower	5,929
Total	**$711,360**

I. *Celanese (#14-07852)*

During the years at issue, Celanese Corp. (Celanese) manufactured ethylene-vinyl acetate beads for use in other chemical manufacturing processes at a facility in Edmonton, Alberta, Canada.

[*37] The manufacturing process generated VOC byproducts of acetic acid, ethylene, vinyl acetate, and naphtha.

In August 2013 Celanese issued to CPI terms and conditions for a project, which included a clause 11 entitled "Rights in Deliverables; No License." Clause 11 stated that CPI agreed "that any deliverables or other work product arising from the Services shall be the property of and owned by Celanese, and shall be considered Confidential Information hereunder." Clause 11 further stated in relevant part that CPI "hereby assigns to Celanese any and all (a) inventions, discoveries or improvements thereof, patentable or otherwise" and "(b) all other copyright and derivatives, trade secret and other proprietary rights that arise out of the performance of the Services or that are applicable to any deliverables under the Purchase Order." Clause 11 further stated that any deliverables that are eligible for copyright protection "shall be considered "work made for hire" and Celanese will be considered the author of such work." Finally, clause 11 provided that, in the event that such deliverables were "deemed for any reason not to be a work for hire," CPI "hereby assigns all rights, title and interest in the copyright of such work" to Celanese.

Next, clause 12 provided restrictions on Confidential Information, requiring CPI to "hold the Confidential Information in strictest confidence" and "not disclose the Confidential Information, or cause or allow it to be disclosed to any third party or use the Confidential Information for any purpose other than as expressly contemplated by the Purchase Order. Clause 12 provided that CPI could "not disclose any Confidential Information to any third party . . . unless and until Celanese has furnished written consent."

In December 2013 WorleyParsons, an engineering firm retained by Celanese to supervise the project, provided CPI with an extensive report detailing the specifications and requirements for the oxidizer. The report stated that Celanese required a regenerative thermal oxidizer with destruction efficiency of 98%; the report also provided a design basis for the oxidizer, which provided a number of relevant measurements and calculations (including a minimum winter temperature of −46 degrees Celsius and the various concentrations of VOCs in the airflow), and a drawing setting out the process flow for the oxidizer. The report also provided a list of Celanese's preferred vendors for the various components and control systems. In addition, Celanese provided CPI with copies of (1) its standard engineering practices for

[*38] control systems; (2) standard maintenance procedures for bolted joint assembly; and (3) electrical specifications.

CPI began work on a proposal. CPI identified several potential issues, for example, the extreme winter temperatures in Edmonton, which might require design changes. Using the information provided by Celanese and WorleyParsons, CPI personnel input the provided VOC levels into Bessy spreadsheets, which calculated that the LEL of the airflow would be 4.2%.[17] That low LEL allowed CPI to omit a hot gas bypass from the design. Similarly, CPI personnel entered the provided specifications into a spreadsheet, which output the appropriate size of the fan components. With respect to the gas train component, on January 8, 2014, Mr. Betz emailed a representative at Maxon to ask about how to design the component for use in a minimum temperature of −50.8 degrees Fahrenheit. The Maxon representative responded that CPI should try to work with the customer to have the component meet −45 or −40 degrees Fahrenheit minimum temperatures instead, because of the difficulty in supplying components that met such low temperatures.

In May 2014 CPI submitted a revised proposal to Celanese. In the proposal, CPI stated that it "accepts Celanese terms and conditions 8-1-2013 with the termination language detailed on page 36 of this proposal." The proposal also stated in relevant part that the system was being "designed for outdoor installation and a temperature rating of −40 [degrees] C (−40 [degrees] F) [sic]." In June 2014 Celanese issued a purchase order to CPI for the oxidizer, for a total price of $897,000.[18]

In July 2014 S.F. completed an initial general arrangement drawing for the project, which was checked by F.C. Also in July 2014, R.J. completed P&ID drawings for the oxidizer. CPI engaged Quantum Design to fabricate a control panel enclosure, Lantec to supply a ceramic heat exchanger, and IVI North to fabricate and supply an exhaust stack for the system, including "[e]ngineering and design (fabrication drawings)." In August 2014 R.J. completed initial electrical schematic

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[17] CPI personnel also entered different combinations of VOCs at higher volumes into several alternative Bessy spreadsheets to account for a possible worst-case scenarios, which resulted in an 8% LEL.

[18] In February 2015, Celanese issued a change order, memorializing an additional $33,000 in unplanned services to be performed by CPI. Those services largely related to an apparent misunderstanding between the parties as to the scope of CPI's work on the electrical system.

[*39] drawings for a control panel. R.J. later requested that Quantum Design complete the final design drawings for the electrical schematics, in part because CPI's work was being closely scrutinized by WorleyParsons. Quantum Design provided CPI with a quote to design the control enclosure for the oxidizer. Under its terms Quantum Design would provide engineering design and drawings "using CPI provided standard templates and nameplates." As the project progressed, WorleyParsons and Celanese requested revisions to the design, which CPI incorporated. In September 2014 R.J. traveled to Canada for meetings with Celanese representatives; in those meetings, Celanese requested a number of changes to the design of the control panel, which R.J. conveyed to Quantum Design.

As of early February 2015 the oxidizer was not yet assembled or installed. Celanese had informed CPI that it needed to meet Canadian building code standards for the control house component of the system, which delayed the project; eventually CPI and Celanese agreed to purchase a control house in Canada and have CPI pipe and wire it to meet the Canadian standards. In early April 2015 R.J. prepared a document that described the details of the control house. At some point thereafter, the oxidizer was installed at the Celanese facility by a third-party contractor. In March 2016 the oxidizer system underwent third-party emissions testing and failed the efficiency requirements. As with the 3M Hutchinson project, CPI discovered that a poppet valve was failing to seal and sent a service technician to fix it.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

[*40]

Component	*Cost*
Booster fan	$22,056
Burner	6,416
Ceramic media	32,106
Cold face support	89,288
Combustion air piping	1,680
Combustion blower	4,894
Control house	4,936
Electrical loose parts	7,196
Electrical panel	95,371
Exhaust expansion joint	837
Exhaust stack	43,550
Fresh air damper, pneu. act.	4,255
Gas train	4,382
Isolation damper, pneu. act.	5,801
Manual balancing damper	1,344
Mechanical loose parts	2,732
Media chamber	28,408
Poppet housing	25,261
Poppet valve assemblies	23,044
Total	**$403,556**

[*41] J. *Smalley (#14-07658)*

During the years at issue, Smalley Steel Ring Co. (Smalley) manufactured heat-treated fasteners for aircraft engines at a facility in Lake Zurich, Illinois. Smalley's heat-treating process generated oil and grease byproducts that burned off into visible smoke. Before contacting CPI, Smalley relied upon condenser equipment, evocatively known as Smog-Hogs, which intake and cool smoke-filled air, causing the oil and grease droplets to condense, before then releasing the cleaned air back into the manufacturing area. However, the condenser process created an oil byproduct that could leak, presenting a potential quality and maintenance problem that Smalley wished to avoid. CPI personnel visited the jobsite, took measurements of the airflow, and ran tests. Because of the variety of chemical compounds CPI found present at the site and constraints on using blowers at the site, CPI determined that a thermal oxidizer with a vertical combustion chamber would be optimal.[19]

In December 2013, after completing onsite measurements, CPI submitted a proposal for an 800 SCFM direct thermal oxidizer, described as a "smoke abatement" system, which Smalley accepted. The proposal stated, in relevant part, that the system would convert the oil smoke and mist emissions to carbon dioxide and water vapors, creating a "cleaner, more maintenance-free abatement system." Also in December 2013 Smalley sent CPI a purchase order for the oxidizer, for a total price of $153,500; the purchase order attached terms and conditions. Clause 6 of the terms and conditions provided:

> Seller will keep confidential all information, drawings, specifications or data furnished by Buyer and shall not divulge or use such information, drawings, specifications or data for the benefit of any third person or entity or for any purpose other than the performance of this Order. Except as required for the performance of this Order, Seller will not make copies or permit copies thereof to be made without the prior written consent of Buyer; Seller will, upon completion of this Order, return such information, drawings, specifications and data to Buyer and make no further use, either directly or indirectly, of any such data

[19] A vertical combustion chamber is essentially akin to a chimney, in which hot air is induced to rise upward.

[*42] or of any information derived therefrom without obtaining Buyer's prior written consent.

Clause 10 of the terms and conditions provided in relevant part:

> Unless Buyer and Seller otherwise agree in writing, the following provisions shall apply to any tools, tooling, patterns, equipment, materials or other properties used in the manufacture of the Goods for Buyer or in the performance of this Order, that are either supplied to Seller by Buyer or have been acquired by Seller and specifically paid for by Buyer. All such properties (including scrap) shall hereafter be referred to as "Buyer-Owned Property". (a) Seller shall have the right to use Buyer-Owned Property without payment for usage as required in the performance of this Order or other work for Buyer, but shall not use Buyer-Owned Property in the performance of any other work without prior written approval of the Buyer. Title to all Buyer-Owned Property shall at all times remain with Buyer. Title to all Buyer-Owned Property which is procured or manufactured by Seller for Buyer shall be fully invested in Buyer upon payments for same by Buyer.

In January 2014 CPI personnel collected samples of the oil condensation, coated a steel sample with the condensation, and then placed the sample in a furnace at the Smalley facility, in order to observe at what temperature the smoke emissions from the condensation were no longer present. CPI personnel also entered specifications into spreadsheets and performed calculations in order to size components, such as the combustion chamber and the burners. Also in January 2014 R.J. completed electrical schematic drawings for a control panel. The control system was designed to automatically turn the burners on and off according to whether Smalley's heat furnaces were generating visible smoke emissions. CPI engaged Quantum Design to fabricate a control panel enclosure and Modern Equipment Co. (Modern Equipment) to fabricate and assemble the oxidizer. After the oxidizer was assembled, a quality audit conducted by CPI personnel revealed that Modern Equipment had not followed CPI's drawings closely enough, leading to some components' needing to be reassembled by CPI personnel. CPI personnel then installed the oxidizer at the Smalley facility. After installation, CPI personnel modified the control system's sequence of

[*43] operations to account for the system's delay in responding to measured temperatures.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

Component	*Cost*
Burner	$1,462
Combustion air piping	1,356
Combustion blower	1,374
Electrical panel	10,504
Gas train	2,337
Total	**$17,033**

K. *Isola I—IR (#14-07607)*

During the years at issue Isola Laminate Systems Corp. (Isola) manufactured plastic and fiberglass boards at a facility in Chandler, Arizona. That manufacturing process generated VOC byproducts such as various plasticizers and phenolic resin. Before engaging CPI, Isola used an older thermal oxidizer (supplied previously by CPI) that had caught fire and was no longer achieving the necessary destruction efficiency.

In October 2013 CPI submitted a proposal for replacing various components of the oxidizer. The proposal provided extensive specifications for the oxidizer, including sizes and manufacturers for the various components, and provided a 99% destruction efficiency guarantee. The proposal specifically noted that the design would incorporate several enhancements that had "proved very successful" on similar recent oxidizers. Finally, the proposal noted that the replacement components would "maintain the same footprint as the original making the installation as seamless as possible and providing little disruption to the process." After some revisions, Isola accepted CPI's proposal. In November 2013 Isola sent CPI a purchase order for the thermal oxidizer equipment, for a total price of $480,000.

[*44] CPI personnel performed calculations to determine the sizing of components, such as the combustion chamber and the burner. After sizing the fan component, CPI sought to reduce the risk of resins' catching fire by engaging a subcontractor to make a hinged fan that could be easily cleaned. After installation, CPI encountered an issue where a leg of the system had incurred some shell fracturing due to heat. CPI resolved this by reinforcing the leg. The system passed its third-party compliance testing and was accepted by the customer.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

Component	*Cost*
Booster fan	$11,931
Burner	8,976
CO#1 EXP JT MB	22,656
Combustion blower	3,562
Compressed air piping	487
Electrical boxes	553
Gas train	6,986
Mechanical loose parts	293
Total	**$55,444**

L. *Isola II—SR (#14-07890)*

At this plant, located at the same facility as the Isola I project, Isola manufactured coating for plastic and fiberglass boards. CPI determined that a self-recuperative thermal oxidizer, in which the heat exchanger is separated from the combustion chamber, would be optimal. In June 2014 Mr. Betz completed an initial P&ID drawing for the oxidizer. In June 2014, CPI sent Isola a revised proposal for a 6,000 SCFM recuperative thermal oxidizer. The proposal described the applicable VOCs as including acetone, MEK, butanol, PM, PMA, and PNB and described the maximum air temperature and maximum VOC

[*45] concentration of the process airflow. The proposal provided a 99% destruction efficiency performance guarantee. C.H. was the sales engineer on the project.

In July 2014 Isola and CPI exchanged purchase and sale orders for the thermal oxidizer, for a total price of $628,200. CPI personnel performed calculations as to the sizing of components, such as the combustion chamber and the burners. CPI revised their sizing calculations and design several times because of the system's potentially not fitting in the allocated space of Isola's facility. In September 2014 R.T. completed an initial general arrangement drawing for the oxidizer, which was submitted to Isola for approval on September 22, 2014. CPI engaged PRE-Heat to fabricate and supply the oxidizer system (including an exhaust stack) and engaged Quantum Design to fabricate and supply the control panel enclosures. After installation of the oxidizer by the customer, CPI's supervising startup technicians discovered an air pressure issue that required modifications to the control system programming.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

[*46]

Component	*Cost*
(3) VFD's	$5,953
BF DPS & enclosure	307
BF inlet PSH	1,175
BF inlet PT & enclosure	880
BF outlet EXP J S/S	912
Booster fan NON insulated	10,982
Ceramic saddle	6,164
Cleanout platform and ladder	8,610
Flame safety	681
Fresh air damper & actuator 18"	4,993
Hx DPS	245
Inlet plenum w/door	3,851
Insulated inlet	14,381
Isolation dampers & act (2) 26"	7,823
Oxidizer fabrication	176,210
Oxidizer fasteners	1,206
PLC	29,760
Pre-filter	149
Press control dampers & act (2) 22"	9,440
Primary heat exchanger	55,602
Secondary heat exchanger	25,096
Secondary Hx EXP joint	3,356
Secondary Hx PIT	1,125
Secondary Hx TE	76
Thermocouples	253
Burner	10,258
Gas train	5,593
Manual shut off valve	260
Seal air blower (heat exchanger)	2,701
Engineering add-ons	79
Exhaust stack ECO #1	11,553
Total	**$399,674**

[*47] M. *Goodyear Lawton (#14-07925)*

During the years at issue, the Goodyear Tire & Rubber Co. (Goodyear) operated a tire manufacturing facility in Lawton, Oklahoma. As of 2014 Goodyear used an older regenerative thermal oxidizer at the Lawton facility, which had been experiencing regular repair issues with its heat exchanger because of clogging from talcum powder used in the manufacturing process. The primary VOC byproduct of the Lawton facility was ethanol.

CPI was invited to submit a proposal to replace the existing oxidizer. In August 2014 CPI submitted a revised, final proposal for a 50,000 SCFM regenerative thermal oxidizer for a total price of $827,500, described as a TRITON system, which Goodyear accepted. The proposal memorialized the characteristics of the process airflow at the Lawton facility, including temperature, volume, heat content, and type of VOC. The proposal also stated that the process airflow would be ducted to an existing mixer dust system to filter out particulate before it reached the oxidizer inlet. Finally, the proposal included a 98.5% destruction efficiency performance guarantee. Goodyear accepted the proposal.

After the acceptance of the proposal, Mr. Harmsen determined that a more expensive, plug-resistant type of ceramic heat exchanger might be optimal for the project, as it would allow particulate to more easily pass through. Mr. Harmsen proposed the different heat exchanger to Goodyear, which agreed to incorporate it into the design at a higher cost. In September 2014 C.D. prepared an initial P&ID drawing, which was checked by F.C. Also in September 2014 S.F. prepared an initial general arrangement drawing for the oxidizer, which was also checked by Mr. Costanzo.

CPI engaged IVI North to fabricate and supply various components of the oxidizer and Lantec to supply the multilayer ceramic media component. After fabrication was completed, Goodyear hired a crew to install the oxidizer itself at the Lawton facility. In August 2015 Goodyear contacted CPI to inform them that the oxidizer had failed performance testing, reaching only 93% destruction efficiency. CPI resolved the issue during a subsequent inspection.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

[*48]

Component	*Cost*
Booster fan	$38,657
Burner	3,396
Ceramic media	2,936
Cold face support	103,840
Combustion air piping	575
Combustion blower	2,202
Control house	19,135
Electrical panel	45,642
Exhaust stack	80,275
Fresh air damper	5,302
Gas train	11,292
Mechanical loose parts	8,026
Media chamber	4,884
Poppet housing	35,496
Poppet valve assemblies	30,848
Exhaust stack expansion joint	1,195
System insulation & paint	55,000
Total	**$448,702**

N. *Wenner (#14-0800)*

During the years at issue Wenner Bread Products, Inc. (Wenner), manufactured artisanal bread at a site in Baltimore, Maryland. During testing for Clean Air Act compliance, Wenner discovered that its specialized yeasts were emitting high levels of ethanol when in the

[*49] baking ovens. Wenner did not have a pollution control system in place and thus contacted CPI for a quote. Wenner provided CPI with specifications about the airflow and ethanol quantities. After reviewing the specifications, CPI determined that a catalytic optimizer would be appropriate, because of the high heat release caused when burning ethanol.

In September 2014 CPI submitted a proposal for a 3,000 SCFM catalytic oxidizer. The proposal included the assumed ethanol concentrations of the process airflow from the baking ovens. The proposal stated that the system would incorporate a ceramic monolith catalyst, which would, in relevant part, provide the ability to "wash" the catalyst. The proposal also stated the system would incorporate a ceramic guard, in order to capture fats, oils, and greases before they reached the catalyst, which would "greatly increase catalyst life by prohibiting active surface area being coated with airborne droplets and particulate." Finally, the proposal included a 98% destruction efficiency performance guarantee. In October 2014 CPI and Dennis Engineering Group LLC (Wenner's engineering consultant) entered into a sales agreement for the purchase and sale of the oxidizer, for a total price of $281,700. C.H. was the sales engineer on the project.

CPI personnel input the provided VOC levels into a Bessy spreadsheet, which calculated that the LEL of the airflow would be 9.68%. Because of the high heat release in the process airflow, CPI thus determined to include a hot gas bypass that vented air directly to the stack and thus avoided excessively preheating the heat exchanger. CPI personnel performed calculations in order to determine the optimal size of various components, including the fan, burner, exhaust stack, and fresh air damper.

In October 2014 C.D. completed electrical schematic drawings for a control panel and CPI engaged Quantum Design to fabricate a control panel and enclosure. In December 2014 R.T. completed an initial general arrangement drawing. CPI engaged PRE-Heat to fabricate and assemble the oxidizer system. Once it was assembled, CPI personnel conducted a quality audit of the oxidizer at PRE-Heat's facility, before the oxidizer was shipped to the Wenner facility. CPI personnel supervised the installation of the system at Wenner's facility. The system successfully passed emissions compliance testing by a third party.

[*50] As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

[*51]

Component	*Cost*
BF outlet exp jnt	$534
BF VFD	1,623
Booster fan	13,945
Burner	3,286
Catalyst	15,540
Catalyst – guard bed	1,400
Combustion air piping & weather hood	1,060
Combustion blower	1,523
Combustion chamber	62,714
Ductwork	4,550
Electrical panel – SEE EXCEL for details	23,890
Exhaust stack	2,468
Fresh air damper	1,723
Gas train	5,907
Heat exchanger	5,143
Mechanical loose parts	4,858
Tee damper	13,613
Total	**$163,778**

O. *East Balt (#14-07950)*

During the years at issue East Balt Commissary, Inc. (East Balt), operated a bakery facility that specialized in making hamburger buns for McDonald's restaurants. East Balt engaged CPI to resolve issues related to ethanol emissions produced by the baking ovens, which had

[*52] been identified as a violation of the Clean Air Act. Mr. Betz was the lead applications engineer on the project, and C.H. was the sales engineer. CPI began its initial bid proposal by visiting East Balt's facility in order to measure the airflow and temperature from the baking oven exhaust. CPI personnel determined that a catalytic oxidizer was the appropriate system for the facility, in part because catalytic conversion was fairly effective with respect to ethanol.

In August 2014 CPI submitted a revised proposal for the design of a catalytic oxidizer, described as a Vector-5. The proposal described the baking oven exhaust as being assumed to be 2,343 and 2,560 SCFM for the two baking ovens, with ethanol at 15–25 lb/hr as the VOC byproduct. The proposal provided a 98% destruction efficiency performance guarantee. The proposal also stated that the oxidizer would include a "ceramic guard bed" downstream from the burner but before the catalyst, which would be "optimum for ensuring all fats, oils, and greases are in vapor phase prior to that catalyst." The guard bed would thus "greatly increase catalyst life by prohibiting active surface area being coated with airborne oil droplets and particulate." In September 2014 East Balt and CPI exchanged purchase and sale orders for the oxidizer, for a total price of $571,500.

In September and October 2014 C.D. completed electrical schematic drawings for a control panel enclosure. In October 2014 R.T. completed an initial general arrangement drawing for the oxidizer. In October 2014 C.D. completed an initial P&ID drawing for the oxidizer. CPI engaged Quantum Design to fabricate the control panel enclosure and PRE-Heat to fabricate and assemble the oxidizer. During the fabrication stage of the oxidizer, the EPA informed East Balt that a system that dispersed air exhaust at a higher elevation would be necessary. CPI extended the exhaust stack design and added structural support in order to prevent it from collapsing in the event of high winds.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

[*53]

Component	*Cost*
Booster fan	$16,832
Burner	466
Catalyst	31,280
Combustion air piping	1,086
Combustion blower	210
Electrical panel	26,052
Expansion joints	2,560
Fresh air damper	4,612
Gas train	7,810
Hardware and gasket	196
I Asbly combustion chamber	58,747
PIT Sitrans	896
Tee damper	20,898
Total	**$171,646**

P. *M&W Ireland (#14-07718)*

During the years at issue M&W Group (M&W) was the general contractor at an Intel Corp. facility in Leixlip, Ireland, which manufactured computer chips and wafers. The primary byproduct of the manufacturing process was liquid ammonium fluoride.

In January 2014 CPI sent a proposal to M&W for a "Trimix Waste Water Treatment System." The proposal stated in relevant part that "this proposal captures the request made during our January 6, 2014 conference call, for CPI to provide an exact copy to the current TRIMIX system that was recently completed." The proposal closely followed specifications provided by Intel. The proposal made some site-specific

[*54] modifications to the previous TRIMIX system design, some of which were made in order for the system to meet European product standards. Those modifications generally involved finding components from Europe that were equivalent to components that CPI had used in the previous TRIMIX system design and then making some sizing adjustments to conform to the differing components. For the project, CPI personnel used a general arrangement design drawing for an ammonia removal system, originally drawn on September 25, 2009. The system was designed to first adjust the pH of the ammonium fluoride in order to separate out the fluoride from the ammonia. From there, the ammonia would be removed from the liquid stream into the air by an air stripper, with the process airflow then being blown into a catalytic oxidizer and converted to nitrogen oxides. The airflow would next encounter a secondary "selective reduction catalyst," which would convert the nitrogen oxides into regular nitrogen.

In February 2014 M&W sent to CPI a purchase order for the oxidizer system and components, for a total price of $3,836,100. CPI engaged PRE-Heat to fabricate and assemble various components of the system. CPI engaged Murphy Matson O'Sullivan, an Irish engineering consulting firm, to determine the location of the oxidizer's foundation and calculate the necessary depths for anchoring the system. This was a relevant aspect of the design, because the Leixlip facility experienced high winds. Using information provided by M&W as to the gallons per minute and VOC concentration range, CPI personnel entered specifications into a spreadsheet to determine the potential size of components and the system's energy requirements. CPI submitted design drawings to M&W, which provided comments and asked for certain modifications. Ultimately, the system was installed at the Leixlip facility and passed performance testing.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

[*55]

Component	*Cost*
Booster fan – parts	$160,974
Loose ship – parts	51,776
Oxidizer – parts	247,629
S4 – parts	48,648
Spares – parts	79,563
Sparge – parts	121,614
Stripper/Eff pump – parts	34,580
TRIMIX – parts	19,774
Total	**$764,559**

Q. *Enterprise (#14-07851)*

During the years at issue Enterprise Products Partners L.P. (Enterprise) operated a natural gas production facility in Rifle, Colorado. Enterprise had two existing 20,000 SCFM regenerative thermal oxidizers that were experiencing an operational problem where ice built up on the system's inlet during cold temperature periods in the winter. Before 2014 CPI had developed a solution to the problem of extreme temperature, by which airflow was recirculated back to the fan inlet in order to prevent condensation and freezing from low temperatures. CPI personnel had written an article about this solution; personnel at Enterprise read the article and then asked CPI to visit its facility and inspect its oxidizer system.

At Enterprise's request, Messrs. Betz and Harmsen visited the Rifle facility to inspect the regenerative thermal oxidizers in use there. Enterprise also provided Mr. Harmsen with the general arrangement design drawing for one of the existing oxidizers. On January 2, 2014, Mr. Harmsen provided Enterprise with a report on the operations of the regenerative thermal oxidizers, including the characteristics of the process airflow. The report identified some pin hole leaks in the current system and described inadequacies with the process air fan inlet design, hot gas bypass damper, and fresh air fan. The report described how the

[*56] existing hotside bypass dampers, which had failed multiple times, differed from CPI's standard hotside bypass damper. The report recommended that Enterprise install a hot gas bypass recirculation system, as designed by CPI, and an internally insulated VOC hot gas bypass. The report also included a version of the general arrangement drawing, which Mr. Harmsen had modified by pasting in the ductwork component from a previous project, in order to represent how the oxidizers could circulate fresh air without temperature issues at the inlet of the oxidizer.

In June 2014 CPI sent Enterprise a proposal for the supply of (1) two designed hot air recirculation systems and (2) two internally insulated VOC hot gas bypasses. The proposal described the hot gas bypass recirculation system as intended to "maintain 300 F inlet temperatures and allow for more accurate control and adjustment to process changes" and "keep the inlet side of the RTO above the acid dew point and prevent freeze ups." The proposal described the VOC hot gas bypass as intended to "direct clean hot air directly into the exhaust stack to de-rate the thermal efficiency of the Oxidizer." Also in June 2014, Enterprise sent CPI a purchase order for the components, for a total price of $435,000; the purchase order attached terms and conditions. Clause 16 of the terms and conditions was entitled "Data Ownership" and provided the following:

> Buyer shall, at all times, be the owner of all information and materials resulting from Supplier's services, including sketches, layouts, negatives, photographs, designs, blueprints, and specifications relating thereto, and of the work product of all services furnished or performed under this order, including all creative ideas included therein, by Supplier or any subcontractor of Supplier in connection with this order. Upon the completion, or in the event of the cancellation or termination of this order, all copies of such information, materials, and work product shall be returned and delivered to Buyer by Supplier. Buyer may copy or reproduce any and all such information, materials, and work product for any and all purposes and may use the same in any and all media as often as it may so desire. No copies or reproductions thereof shall be made or retained by Supplier except as authorized in writing by Buyer.

Clause 17 was entitled "Confidentiality" and stated that "[n]o information relative to this order concerning the purchase or use of

[*57] goods or services may be published or disseminated by Supplier without the Buyer's prior written consent."

In September 2014 G.B. prepared an initial general arrangement drawing, which copied the general arrangement design of the existing oxidizer and added the proposed components. CPI engaged Global Fab to fabricate and assemble various aspects of the components. The components were installed at the Rifle facility at some point in 2015.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

Component	*Cost*
Blower	$52,653
Damper & ductwork	158,370
Total	**$211,023**

R. *DuPont La Porte (#14-07831)*

During the years at issue, E.I. DuPont de Nemours & Co. (DuPont) operated a chemical manufacturing facility in La Porte, Texas. The manufacturing process at the facility generated VOCs such as methyl methacrylate and acetic acid. CPI determined that a direct thermal oxidizer would be optimal.

In May 2014 CPI sent DuPont a revised proposal, which DuPont accepted. The proposal was more detailed than was CPI's normal practice and included extensive specifications for the various components of the system. The proposal included a 99.9% destruction efficiency performance guarantee. The proposal stated that the system would incorporate "a low emissions burner specially designed to process mixed gases" which would be sized for 6 million BTU/hour. Also in May 2014 CPI issued a sales order to DuPont for the thermal combustor, which noted that no fabrication would begin until approval documentation was received from DuPont. The sales order was for a total price of $769,900.

Ultimately, CPI purchased a high intensity fuel-gas burner for the system. DuPont provided CPI with the VOC levels for two particular process airflows at the La Porte facility. CPI personnel input the

[*58] provided VOC levels for the first airflow, primarily consisting of methanol and acetates, into a Bessy spreadsheet, which calculated that the LEL of the airflow would be 62.5%. CPI personnel then input the provided VOC levels for the second airflow, primarily consisting of nitrogen from a tank farm at the facility, into a Bessy spreadsheet, which calculated that the LEL of the airflow would be 330.4%. Because of the high LEL, CPI personnel determined that the oxidizer would need to burn the process airflow directly, without mixing it with additional oxygen. CPI personnel entered the provided specifications into another spreadsheet to determine the sizing of components, such as the process fan.

In August 2014 R.T. completed an initial general arrangement drawing for the system, which was checked by F.C. The extremely large size of the exhaust stack was somewhat unusual for CPI and was outside their design capability. Accordingly, CPI engaged IVI North to both design and fabricate a stack to a number of provided sizing and feature specifications.

With respect to the electrical system, CPI was responsible for designing only the burner control and management system, with the remainder of the oxidizer's operations being programmed by DuPont into its existing control system at the La Porte facility. The design of the burner control system went through an extensive design review with DuPont. R.J. started from CPI's standardized P&ID drawings but eventually made a number of revisions at DuPont's request. The process of revising CPI's standardized designs for the various components of the system was similarly extensive, with DuPont offering multiple revisions. The oxidizer was installed by DuPont at the La Porte facility at some point in 2015 or 2016 and subsequently passed third-party compliance testing.

As part of the research credit study, Alliantgroup did not include any supply costs associated with the DuPont project in its qualified research expenditures calculations.

S. *Reclaimed Energy (#14-07981)*

During the years at issue Superior Oil Co., Inc.'s Reclaimed Energy Division (Reclaimed Energy) operated a facility in Connersville, Indiana. At the facility, Reclaimed Energy recycled used chemical solvents from other manufacturing processes and distilled them down to clean elements. Because of that business model, Reclaimed Energy's

[*59] process involved a wide variety of VOCs. Reclaimed Energy was a longtime customer of CPI and, in 2014, already used two CPI-supplied catalytic oxidizers at its facility. Because of that customer relationship, CPI already had a significant amount of institutional knowledge and information about the Connersville facility and the process airflow. CPI personnel determined that the existing catalytic oxidizers lacked sufficient capacity during high VOC emission periods.

CPI personnel determined that a new regenerative thermal oxidizer would be appropriate, sized at 15,000 SCFM. In September 2014 CPI submitted a proposal for a 15,000 SCFM regenerative thermal oxidizer, described as a Triton 15.95. The proposal included the characteristics of the process airflow, including the volume, temperature, heat value, and maximum estimated VOC load. The proposal also included a 98% destruction efficiency performance guarantee. Reclaimed Energy then sent to CPI a purchase order for the oxidizer, for a total price of $449,800. Using the known characteristics of Reclaimed Energy's process airflow, Messrs. Betz and Harmsen calculated the sizes of various components, such as the fan and fresh air damper, basing them upon the volume, air pressure, and inlet temperature. In October 2014 Mr. Betz completed a P&ID drawing for the oxidizer; the P&ID drawing was based on a previous one completed for Reclaimed Energy with modifications. Also in October 2014 S.F. completed an initial general arrangement drawing for the oxidizer, which was checked by T.Z.

CPI engaged Lantec to fabricate and supply the multilayer ceramic media component, Global Fab to fabricate and assemble various components of the oxidizer, and IVI North to fabricate and supply an exhaust stack. In October and November 2014 C.D. completed various electrical schematic drawings. In November 2014, Quantum Design made a number of suggested revisions to the drawings, to which CPI agreed. CPI then engaged Quantum Design to fabricate and supply the control panel and enclosures. In early 2015 S.F. and other CPI employees completed a number of other design drawings for components of the oxidizer. A number of components of the oxidizer were ordered from suppliers in 2015. Ultimately, the oxidizer was installed by Reclaimed Energy at the Connersville facility at some point in 2015.

As part of the research credit study, Alliantgroup calculated that the following supply costs were qualified research expenditures:

[*60]

Component	*Cost*
BF outlet exp joint	$681
BF VFD	6,060
Booster fan	17,124
Burner	1,097
Ceramic media	22,695
Cold face support	8,798
Combustion air piping	5,112
Combustion blower	2,450
Duct from CC to stack	3,349
Electrical loose parts	1,260
Electrical panel	37,407
Exhaust stack	41,085
Exhaust stack flex	875
Fresh air damper, pneu. act.	4,142
Gas train	11,765
Hardware and gaskets	3,076
Hot gas bypass damper – insulated	13,088
Inlet transition duct	979
Mechanical loose parts	3,918
Media chamber	92,627
Poppet housing	19,019
Poppet valve assemblies	35,270
Total	**$331,877**

VII. *Tax Reporting*

On April 20, 2015, CPI filed a Form 1120S, U.S. Income Tax Return for an S Corporation, for tax year 2014. On Form 6765 for tax year 2014 CPI reported a research credit of $501,531 under section 41 after electing a reduced credit under section 280C(c).[20] Schedules K–1, Shareholder's Share of Income, Deductions, Credits, etc., were issued to petitioners Mark Betz and Julia Lincoln, reporting $250,765 as a research credit on line 13. On April 15, 2015, petitioners Mark and Christine Betz and petitioners Julia and Dennis Lincoln jointly filed Forms 1040, U.S. Individual Income Tax Return, for tax year 2014. On their Form 3800, General Business Credit, Mr. and Mrs. Betz reported

[20] CPI also claimed a deduction of $171,489 for research and development.

[*61] a research credit of $250,766, of which they claimed $128,898 on line 54 of their Form 1040. On their Form 3800, Mr. and Mrs. Lincoln reported a research credit of $250,765, of which they claimed $122,651 on line 54 of their Form 1040.

Mr. and Mrs. Betz jointly filed Form 1040 for tax year 2015. On Form 3800 they reported a carryforward of the research credit of $104,708, of which they claimed $58,198 on line 54 of their Form 1040. Mr. and Mrs. Lincoln jointly filed a Form 1040 for tax year 2015. On Form 3800 they reported a carryforward of the research credit of $129,682, of which they claimed $31,718 as part of their other credits total on line 54 of their Form 1040.

Mr. and Mrs. Betz jointly filed Form 1040 for tax year 2016. On Form 3800 they reported a carryforward of the research credit of $46,510, of which they claimed $43,780 on line 54 of their Form 1040. Mr. and Mrs. Lincoln jointly filed Form 1040 for tax year 2016. On Form 3800 they reported a carryforward of the research credit of $97,964, of which they claimed $32,866 on line 54 of their Form 1040.

The 2014 Form 1120S and the 2014, 2015, and 2016 Forms 1040 for both couples were prepared by the accounting firm Porte Brown LLC. Jeffery R. Smiejek, a partner at Porte Brown, signed all seven returns as preparer. Porte Brown prepared the original underlying Form 6765, which reported the section 41 credit, by transcribing the numbers from the pro forma Form 6765 that Alliantgroup delivered to petitioners on April 10, 2015. On November 2, 2015, Alliantgroup emailed Porte Brown a brief memo describing the research credit's requirements and attaching spreadsheets with the claimed wage and supply costs.

VIII. *The Notices of Deficiency and Petitions*

On July 26, 2018, respondent issued to petitioners Mark and Christine Betz a notice of deficiency, which made the following determinations:

Year	*Deficiency*	*Penalty § 6662*
2014	$128,898	$25,779.60
2015	58,198	11,639.60
2016	43,780	8,756.00

[*62] On July 26, 2018, respondent also issued to petitioners Julia and Dennis Lincoln a notice of deficiency, which made the following determinations:

Year	*Deficiency*	*Penalty § 6662*
2014	$121,083	$24,216.60
2015	31,718	6,343.60
2016	32,866	6,573.20

Each couple timely filed a Petition with this Court.

OPINION

I. *Jurisdiction and Burden of Proof*

Where a notice of deficiency issued to an S corporation shareholder includes adjustments to both S corporation items and other items unrelated to the S corporation, we have jurisdiction to determine the correctness of all adjustments in the shareholder-level deficiency proceeding. *See Johnson v. Commissioner*, No. 19973-18, 160 T.C., slip op. at 11 (Jan. 25, 2023) (citing *Winter v. Commissioner*, 135 T.C. 238, 245–46 (2010)). We thus have jurisdiction to determine the correctness of both respondent's adjustments to petitioners' pro rata shares of CPI's claimed research credit and any other determinations in the notices of deficiency.

The Commissioner's determinations as expressed in the notice of deficiency are presumed correct, and the taxpayer bears the burden of proving that they are erroneous. Rule 142(a)(1); *Welch v. Helvering*, 290 U.S. 111, 115 (1933); *VHC, Inc. v. Commissioner*, 968 F.3d 839, 841 (7th Cir. 2020), *aff'g* T.C. Memo. 2017-220. Credits are a matter of legislative grace, and taxpayers must demonstrate their entitlement to credits claimed. *See Feigh v. Commissioner*, 152 T.C. 267, 270 (2019) (citing *INDOPCO, Inc. v. Commissioner*, 503 U.S. 79, 84 (1992)); *see also United Stationers, Inc. v. United States*, 163 F.3d 440, 443 (7th Cir. 1998). Petitioners have neither alleged nor established that they meet the requirements of section 7491(a) as necessary to shift the burden of proof to respondent on any factual issues.

[*63] II. *Section 41 Research Credit*

A. *Basic Structure*

Section 38 provides taxpayers with a current-year business credit that includes a credit for research expenses as determined under section 41(a). Section 41(a)(1) specifies that the research credit shall be an amount equal to 20% of the excess of the taxpayer's qualified research expenses (QREs) over the base amount. QREs are limited to amounts "paid or incurred by the taxpayer during the taxable year in carrying on any trade or business."[21] § 41(b)(1); *see* § 7701(a)(25). QREs may be either in-house research expenses or contract research expenses. § 41(b)(1). In-house research expenses include (1) "any wages paid or incurred to an employee for qualified services performed by such employee" and (2) "any amount paid or incurred for supplies used in the conduct of qualified research." *Id.* para. (2)(A)(i) and (ii). Qualified services are defined as either (1) "engaging in qualified research" or (2) "engaging in the direct supervision or direct support of research activities which constitute qualified research." *Id.* subpara. (B); *see* Treas. Reg. § 1.41-2(c) (defining "direct supervision" and "direct support"). If at least 80% of the services an employee performed during the taxable year were qualified services, then the taxpayer may treat 100% of that employee's wages as being paid or incurred for qualified services. Treas. Reg. § 1.41-2(d)(1) and (2).

To constitute qualified research, a research activity must satisfy a four-part statutory test. § 41(d)(1). If the research activities corresponding to a particular product as a whole fail to satisfy the four-part test, we may re-apply the test to subsets of the product. *See* Treas. Reg. § 1.41-4(b)(2) (providing the "shrinking-back rule"). Several statutory exclusions, *see* § 41(d)(4), set forth categories of activities that are excluded from the definition of qualified research (and thus cannot be creditable), *see* § 41(d)(1) (flush language) ("[Qualified research] does not include any activity described in paragraph (4)."); *see also Eustace v. Commissioner*, 312 F.3d 905, 908 (7th Cir. 2002) ("Sections 41(d)(1) and (d)(4) are independent rules, which deserve, and have received, independent constructions."), *aff'g* T.C. Memo. 2001-66, 81 T.C.M.

[21] For an accrual method taxpayer such as CPI, a liability is incurred and taken into account for the taxable year in which (1) all the events have occurred that establish the fact of the liability; (2) the amount of the liability can be determined with reasonable accuracy; and (3) economic performance has occurred with respect to the liability. *See VECO Corp. & Subs. v. Commissioner*, 141 T.C. 440, 459 (2013); *see also* § 461(h); Treas. Reg. § 1.461-1(a)(2)(i).

[*64] (CCH) 1370. One such exclusion provides that "[a]ny research related to the adaptation of an existing business component to a particular customer's requirement or need" is excluded from the definition of qualified research. § 41(d)(4)(B).

The base amount for purposes of section 41 is equal to the product of the average of the taxpayer's annual gross receipts for the four preceding years, multiplied by a fixed-base percentage.[22] § 41(c)(1). The fixed-base percentage is generally the percentage calculated by dividing (1) the taxpayer's aggregate QREs for tax years beginning after December 31, 1983, and before January 1, 1989, by (2) the taxpayer's aggregate gross receipts for those same tax years. *Id.* para. (3)(A). The fixed-based percentage cannot exceed 16%. *Id.* subpara. (C). The base amount cannot be less than 50% of the QREs for the credit year. *Id.* para. (2).

In the case of an S corporation, the amount of a claimed section 41 credit is allocated among the shareholders pro rata. *See* Treas. Reg. § 1.41-7(a)(1)(i); *see also* §§ 1366(a)(1)(A), 1377(a)(1). Each S corporation shareholder may then claim the section 41 credit on his or her income tax return in an amount "equal to the amount of tax attributable to that portion" of the taxable income "allocable or apportionable" to their shareholder interest. § 41(g). To the extent an S corporation shareholder's pro rata portion of the section 41 credit for the taxable year exceeds this limitation, that shareholder may carry forward the unused amount of credit to a future taxable year. *Id.* subsec. (g).

B. *Substantiation Principles*

Section 6001 requires, inter alia, that taxpayers keep records in compliance with the rules and regulations prescribed by the Secretary of the Treasury. Accordingly, taxpayers are required to "keep such permanent books of account or records . . . as are sufficient to establish the amount of gross income, deductions, credits, or other matters required to be shown" on a tax return. Treas. Reg. § 1.6001-1(a). With respect to the research credit, the taxpayer specifically "must retain records in sufficiently usable form and detail to substantiate that the expenditures claimed are eligible for the credit." Treas. Reg. § 1.41-4(d). To substantiate wages paid or incurred for qualified services, the taxpayer need not necessarily maintain and produce contemporaneous

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[22] Respondent did not address petitioners' calculation of the base amount in his posttrial briefing, and we thus deem that issue conceded.

[*65] time-tracking records for its employees. *See Union Carbide Corp. & Subs. v. Commissioner*, T.C. Memo. 2009-50, 97 T.C.M. (CCH) 1207, 1268 ("[Treasury Regulation § 1.41-4(d)] does not require that a taxpayer substantiate its research credit claim with any particular types of documents . . . ."), *aff'd*, 697 F.3d 104 (2d Cir. 2012); *Fudim v. Commissioner*, T.C. Memo. 1994-235, 67 T.C.M. (CCH) 3011, 3012 (accepting "testimony and other evidence in the record" as basis for *Cohan* rule estimate of time spent in performing qualified services (citing *Cohan v. Commissioner*, 39 F.2d 540, 544 (2d Cir. 1930)); *see also United States v. McFerrin*, 570 F.3d 672, 679 (5th Cir. 2009).

However, we do not apply the *Cohan* rule to estimate wages paid or incurred if the taxpayer fails to make a threshold showing that a particular employee performed activities that constituted qualified services with respect to a business component. *See Shami v. Commissioner*, 741 F.3d 560, 568 (5th Cir. 2014) ("[T]he *Cohan* rule is not implicated unless the taxpayer proves that he is entitled to some amount of tax benefit[;] [i]n the context of the § 41 credit, a taxpayer would do so by proving that its employee performed some qualified services."), *aff'g in relevant part* T.C. Memo. 2012-78; *Moore v. Commissioner*, T.C. Memo. 2023-20, at *11 ("Even if some of [employee's] activity on these three products was qualified research, we have no basis for estimating how much of his time was so spent."); *see also Mendes v. Commissioner*, 121 T.C. 308, 316 (2003) ("Even under *Cohan*, there must be sufficient evidence in the record to provide a basis upon which an estimate may be made." (citing *Vanicek v. Commissioner*, 85 T.C. 731, 742–43 (1985))); *Coors Porcelain Co. v. Commissioner*, 52 T.C. 682, 697–98 (1969), *aff'd*, 429 F.2d 1 (10th Cir. 1970).

If a business component as a whole fails any of the four qualified research tests, the taxpayer must still show that a particular employee performed qualified services with respect to a particular subset of the component, in order to implicate *Cohan*. *See Eustace*, 81 T.C.M. (CCH) at 1372, 1374 (rejecting taxpayers' attempt to invoke *Cohan* rule when they lacked "the substantiation necessary to tie salaries to activities at the subcomponent level" and merely "delineated the employees and activities" believed to qualify for research credit); *Trinity Indus., Inc. v. United States*, 691 F. Supp. 2d 688, 693 (N.D. Tex. 2010) (declining to apply shrinking-back rule because taxpayer "offered no evidence of the costs associated with any subset" of the product), *aff'd in part and remanded*, 757 F.3d 400 (5th Cir. 2014). Finally, the U.S. Court of Appeals for the Seventh Circuit—to which an appeal in this case would lie, absent stipulation to the contrary, *see* § 7482(b)(1)(A), (2)—has

[*66] previously described the *Cohan* rule as "rarely compulsory" and suggested it is not applicable where the expenses at issue are of a sort where the taxpayer should have been able to produce some form of substantiating evidence, *see Lerch v. Commissioner*, 877 F.2d 624, 628, 629 n.9 (7th Cir. 1989) (quoting *Williams v. United States*, 245 F.2d 559, 560 (5th Cir. 1957) (describing estimate without reasonable basis as "unguided largesse")), *aff'g* T.C. Memo. 1987-295; *see also Buelow v. Commissioner*, 970 F.2d 412, 415 (7th Cir. 1992) (affirming this Court's decision not to apply *Cohan* rule where taxpayer failed to question knowledgeable trial witnesses about expenses at issue), *aff'g* T.C. Memo. 1990-219.

More recently, the Seventh Circuit has had occasion to address the substantiation burden that taxpayers claiming the research credit must bear. *See Little Sandy Coal Co. v. Commissione*r, 62 F.4th 289, 308 (7th Cir. 2023), *aff'g* T.C. Memo. 2021-15. In *Little Sandy Coal Co.*, the Seventh Circuit encountered a similar research credit claim by a taxpayer that relied on trial testimony as substantiation for its estimated QREs; the Seventh Circuit characterized the taxpayer's evidentiary showing as asking this Court "to take on faith" that the allocations of its employees' wages were only for activities constituting qualified research. *Id.* In affirming this Court's decision that the taxpayer had failed to show entitlement to the credit, the Seventh Circuit emphasized that "shortcut estimates of experimentation-related activities will not suffice . . . [s]omething more, such as documentation of time spent on such activities, is necessary." *Id.*

Petitioners largely relied on the trial testimony of Messrs. Betz and Harmsen to carry their substantiation burden. We found Messrs. Betz and Harmsen to be credible with respect to the basic facts of CPI's business process and the technical background of oxidizers, with which they are evidently highly familiar. However, we found their testimony at times to be vague, in conflict with the record, and lacking in credibility with respect to their self-serving characterizations of some of the work performed by CPI on specific projects. *See Conti v. Commissioner*, 99 T.C. 370, 375 (1992) ("It is our task to decide the credibility of any lay or expert witness based upon objective facts, the reasonableness of the testimony, the consistency of the statements made by the witness, and, in some cases, the demeanor of the witness."), *aff'd and remanded*, 39 F.3d 658 (6th Cir. 1994); *see also Lerch v. Commissioner*, 877 F.2d at 631 ("The Tax Court may disregard uncontradicted testimony by a taxpayer where it finds that testimony lacking in credibility."). We will note

[*67] below where our observations of the trial witnesses are particularly relevant to our findings and conclusions.

C. *Qualified Research*

To constitute qualified research, research must satisfy a four-part statutory test:

> Sec. 41(d). Qualified research defined. . . .
>
> (1) In general.—The term "qualified research" means research—
>
> (A) with respect to which expenditures may be treated as expenses under section 174,
>
> (B) which is undertaken for the purpose of discovering information—
>
> (i) which is technological in nature, and
>
> (ii) the application of which is intended to be useful in the development of a new or improved business component of the taxpayer, and
>
> (C) substantially all of the activities of which constitute elements of a process of experimentation for a purpose described in paragraph (3).
>
> Such term does not include any activity described in paragraph (4).

The four-part test is applied separately to each business component. *Id.* para. (2)(A). A "business component" is defined in relevant part as a product or process that the taxpayer either (1) holds for sale, lease, or license or (2) uses in its trade or business. *Id.* subpara. (B). Any plant process, machinery, or technique for commercial production of a business component is itself treated as a separate business component from the underlying product. *Id.* subpara. (C). Here, the business components claimed by petitioners are the oxidizer systems or components of oxidizer systems supplied to CPI's customers.

As noted above, if a business component as a whole fails any of the qualified research tests, the regulations provide a fallback position for taxpayers in the form of the shrinking-back rule. *See* Treas. Reg. § 1.41-4(b)(2). The shrinking-back rule instructs us to re-apply the four-part test to the business component at its "most significant subset of elements." *Id.* If that too fails, we generally drill down to a more

[*68] granular subset of the business component, until either (1) a subcomponent satisfies the tests or (2) the most basic level of the component fails to satisfy the tests. *Id.*

We now turn to the four-part test. Respondent concedes that CPI's claimed activities in 2014 satisfied two parts: the technological information test and the business component test. We thus largely focus on the first requirement in section 41(d)(1) that respondent does challenge: the section 174 test.[23]

1. *Section 174 Test*

To be qualified, research must be research "with respect to which expenditures may be treated as expenses under section 174." § 41(d)(1)(A). We have previously interpreted section 41(d)(1)(A) as incorporating the section 174 requirements on both the nature of the activity and the nature of the expenditure. *See Norwest Corp. & Subs. v. Commissioner*, 110 T.C. 454, 491 (1998) (interpreting section 41(d)(1)(A) as requiring "the taxpayer to satisfy all the elements for a deduction under section 174"); *Union Carbide Corp.*, 97 T.C.M. (CCH) at 1255 (analyzing both whether taxpayer's activities "constitute research and development within the meaning of section 174" and whether the costs of those activities "may be treated as expenses under section 174"). To satisfy the section 174 test, the taxpayer thus must show (1) that the claimed research expenditures would be eligible for a deduction under section 174 and (2) that the claimed research activities constituted research and development within the meaning of section 174. *See Norwest Corp.*, 110 T.C. at 491; *Union Carbide Corp.*, 97 T.C.M. (CCH) at 1274 ("[The taxpayer] cannot avoid the restrictions of section 174 by arguing that section 174 is relevant only for determining whether activities constitute qualified research and has no bearing on whether the costs of those activities may be QREs."). If we conclude that the taxpayer has failed to satisfy the section 174 test at "the level of a product" as a whole, the taxpayer may still satisfy the test "at the level

[23] The process of experimentation test (which respondent also raises) is a higher bar, which requires "essentially the same uncertainty as is required by the section 174 test" but "imposes a more structured method of discovering information than section 174 requires and may not include all actions a taxpayer takes to resolve uncertainty." *Union Carbide Corp.*, 97 T.C.M. (CCH) at 1256.

[*69] of the component or subcomponent of the product."[24] Treas. Reg. § 1.174-2(a)(5) (providing a section 174-specific shrinking-back rule).

On its own, section 174 operates as a narrow, elective exception to the general capitalization rules. *See* §§ 263(a)(1)(B), 263A(c)(2); *INDOPCO, Inc. v. Commissioner*, 503 U.S. at 84 ("[D]eductions are exceptions to the norm of capitalization . . . ."); *see also* Donald C. Alexander, *Research and Experimental Expenditures Under the 1954 Code*, 10 Tax L. Rev. 549, 549–52 (1955) (contrasting pre-1954 treatment of research costs with section 174); David S. Hudson, *The Tax Concept of Research or Experimentation*, 45 Tax Law. 85, 112–20 (1991) (discussing the origins of section 174 as a practical solution to the accounting difficulty of allocating and capitalizing research costs). Section 174(a)(1) allows taxpayers to elect a current-year deduction for "research or experimental expenditures which are paid or incurred by [the taxpayer] during the taxable year in connection with [its] trade or business."[25] *See Spellman v. Commissioner*, 845 F.2d 148, 149 (7th Cir. 1988), *aff'g* T.C. Memo. 1986-403; *see also* Treas. Reg. § 1.174-1. The corresponding regulations define "research or experimental expenditures" as those that "represent research and development costs in the experimental or laboratory sense" including costs "incident to the development or improvement of a product." Treas. Reg. § 1.174-2(a)(1). The regulations further provide:

> Expenditures represent research and development costs in the experimental or laboratory sense if they are for activities intended to discover information that would eliminate uncertainty concerning the development or improvement of a product. Uncertainty exists if the information available to the taxpayer does not establish the capability or method for developing or improving the product or the appropriate design of the product.

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[24] The applicable regulatory preamble describes this rule as "intended to ensure that section 174 eligibility is preserved in instances in which a basic design specification of the product may be established, but there is uncertainty with respect to certain components of the product." T.D. 9680, 2014-32 I.R.B. 254, 256; *see, e.g.*, *Caltex Oil Venture v. Commissioner*, 138 T.C. 18, 34 (2012) (consulting regulatory preamble to resolve ambiguity in regulatory text).

[25] Congress has since amended section 174 to eliminate the option of a current-year deduction and provide instead for mandatory amortization of research and development expenditures for taxable years starting after December 31, 2021. *See* Tax Cuts and Jobs Act of 2017, Pub. L. No. 115-97, § 13206, 131 Stat. 2054, 2111–13.

[*70] *Id.*

We apply a two-step test with respect to whether a taxpayer's activities constituted research and development within the meaning of section 174. First, the taxpayer must show that the information available to it did not establish (1) that the taxpayer was capable of developing or improving the product; (2) the method by which the taxpayer would develop or improve the product; or (3) the appropriate design of the product. *See* Treas. Reg. § 1.174-2(a)(1); *see also Max v. Commissioner*, T.C. Memo. 2021-37, at *29. If information was not available to the taxpayer with respect to establishing either capability, method, or appropriate design, then uncertainty existed. *See Union Carbide Corp.*, 97 T.C.M. (CCH) at 1255. In applying this first step, we examine the information objectively available to the taxpayer, rather than the taxpayer's subjective understanding of that information. *Id.* ("Whether an uncertainty exists is an objective test that depends on the information available to the taxpayer." (citing *Mayrath v. Commissioner*, 41 T.C. 582, 590–91 (1964), *aff'd*, 357 F.2d 209 (5th Cir. 1966))); *see Max*, T.C. Memo. 2021-37, at *30 (finding no uncertainty where appropriate design may have been subjectively unknown to taxpayer but taxpayer "already ha[d] the information necessary to address that unknown"). Second, if uncertainty existed, the taxpayer must still show that it undertook investigative activities that were "intended to discover information that would eliminate uncertainty." Treas. Reg. § 1.174-2(a)(1); *see Max*, T.C. Memo. 2021-37, at *30–31. In *Little Sandy Coal Co. v. Commissioner*, 62 F.4th at 298, the Seventh Circuit recently clarified the nature of the uncertainty required by section 174:

> Generic uncertainty is inherent in constructing or manufacturing a product. That involves questions like: Will this tire fit? What kind of screws are needed to attach this panel? Or will this weld hold up this truss? But "uncertainty" in Section 174 means something more. . . . Expenses incurred merely to determine whether a product is built to satisfy a client's desired specifications—without any indication that the expenses were incurred to improve or develop the concept of the product—do not qualify.

Continuing, the Seventh Circuit looked to the ordinary meaning of "development," as used in Treasury Regulation § 1.174-2(a)(1), and concluded that the term requires some "advancement in technology or product concept" as opposed to "mere construction." *Little Sandy Coal*

[*71] *Co. v. Commissioner*, 62 F.4th at 298. The Seventh Circuit noted the difficulty in establishing uncertainty at the level of a product as a whole, emphasizing that "a manufacturer may not simply 'add a few new bells and whistles' on a pre-existing product and claim uncertainty as to the whole." *Id.* at 299. Finally, the Seventh Circuit noted that, "[i]f summed up in one word, expenses deductible under [s]ection 174 must be 'investigative.'" *Id.* (quoting *Union Carbide Corp.*, 97 T.C.M. (CCH) at 1255).

The section 174 test implicates one more relevant limitation. Expenditures paid or incurred for "ordinary testing or inspection of materials or products for quality control (quality control testing)" are not deductible under section 174. Treas. Reg. § 1.174-2(a)(6)(i). Quality control testing includes "testing or inspection to determine whether particular units of materials or products conform to specified parameters" but "does not include testing to determine if the design of the product is appropriate." *Id.* subpara. (7).

2. *Supply QREs*

We first focus on whether the claimed supply QREs for all 19 projects would be eligible for a deduction under section 174, as a category of expenditure. The record demonstrates that the claimed supply QREs correspond to payments made by CPI to various subcontractors and suppliers for the costs of fabricating, assembling, and supplying components of the oxidizers. CPI does not itself fabricate, assemble, or manufacture any components at its own facility. The "supply" label used by petitioners is thus partially a misnomer here, as the claimed supply QREs appear to encompass not only payments CPI made to its suppliers for the cost of supplies (i.e., physical components) but also certain payments made to its subcontractors for services (e.g., payments labeled in CPI's accounting system as for "assembly" of components).[26] *See* § 41(b)(2)(C) (defining "supplies" as "any tangible property" other than land, improvements to land, and depreciable property).

[26] Petitioners do not contend that the cost of the services the subcontractors performed on the projects constituted contract research expenses incurred by CPI, nor did the Alliantgroup study identify any contract research expenses as part of the credit amount claimed. *See* § 41(b)(3)(A) (providing a limited credit for contract research expenses for research performed by another). Given our conclusions below, we need not speculate as to what amount of the claimed supply QREs would actually be creditable in full.

[*72] Section 174 provides a deduction only for "'expenditures of an investigative nature expended in developing the *concept* of a model or product', as opposed to the construction or manufacture of the product itself." *Union Carbide Corp.*, 97 T.C.M. (CCH) at 1255 (alteration in original) (quoting *Mayrath*, 41 T.C. at 590); *see Little Sandy Coal Co. v. Commissioner*, 62 F.4th at 298 (distinguishing between generic construction uncertainty and uncertainty as to the underlying concept of a model or product); *Kollsman Instrument Corp. v. Commissioner*, T.C. Memo. 1986-66, 51 T.C.M. (CCH) 463, 466 (distinguishing between nondeductible production activities and deductible research activities), *aff'd*, 870 F.2d 89 (2d Cir. 1989). Consequently, a deduction under section 174 is generally not available with respect to costs of production, and claimed QREs incurred in the actual production of a product typically fail the section 174 test. *See Max*, T.C. Memo. 2021-37, at *30–31.

The relevant exception, as set forth in the regulations, is for costs incurred in constructing a prototype or "pilot model," which is defined as "any representation or model of a product that is produced to evaluate and resolve uncertainty concerning the product." Treas. Reg. § 1.174-2(a)(4); *see Little Sandy Coal Co.*, T.C. Memo. 2021-15, at *38–39. The regulations note that "a fully-functional representation or model of the product or . . . component of the product" can still be a pilot model if produced to evaluate and resolve uncertainty. *See* Treas. Reg. § 1.174-2(a)(4). Expenditures incurred for the actual construction of a pilot model are generally deductible under section 174, even if the model itself is ultimately sold to customers. *See* Treas. Reg. § 1.174-2(a)(1) ("The ultimate success, failure, sale, or use of the product is not relevant to a determination of eligibility under section 174."); *see also id.* subpara. (11) (example 7). To qualify for the pilot model exception, the taxpayer must show that (1) uncertainty existed (i.e., an objective lack of information) as to capability, method, or appropriate design of a product, (2) it constructed "a representation or model" of the product, and (3) its purpose in constructing the representation or model was to "evaluate and resolve uncertainty" about capability, method, or appropriate design. *See Little Sandy Coal Co.*, T.C. Memo. 2021-15, at *41 ("[T]he classification of a product as a pilot model turns on the taxpayer's purpose in producing it."); *see also Little Sandy Coal Co. v. Commissioner*, 62 F.4th at 303 ("[T]he creator's intent matters."). Once objective uncertainty is eliminated with respect to the underlying product, any further costs of production do not qualify under section 174. *See* Treas. Reg. § 1.174-2(a)(1), (11) (example 3).

[*73] In their pretrial memorandum, petitioners initially asserted that, because each oxidizer was "uniquely designed for the particular application on which it is being designed," each oxidizer was a pilot model, with costs of its production qualifying under section 174 until the oxidizer was "running in a manner which meets the project requirements." However, petitioners failed to explicitly contend in their posttrial briefing that the oxidizers were pilot models. Petitioners did make on brief the broader, more general argument that the supply costs were for materials "used in the development process, prior to the end of uncertainty of appropriate design [sic]." Similarly, in their posttrial briefing, petitioners referenced on one occasion that the supplies were "utilized in the development of the prototypes." Despite petitioners' failure to explicitly brief the pilot model exception, we find that petitioners' more generalized contentions that the supply costs were QREs necessarily raises this issue for decision.[27] *See Purple Heart Patient Ctr., Inc. v. Commissioner*, T.C. Memo. 2021-38, at *35 n.10 (questioning taxpayer's failure to explicitly brief issue but "nonetheless" addressing issue as "entwined" with other issues properly raised by taxpayer).

In any event, we conclude that petitioners have failed to carry their burden of establishing that the oxidizer systems at issue were pilot models. The record demonstrates that the supply QREs related to the cost of producing functional systems for CPI's customers. Accordingly, in order to satisfy the section 174 test, petitioners are required to show that the supply QREs related to the cost of producing pilot models. While the regulations note that a fully functional representation or model can qualify as a pilot model, the taxpayer must establish that its purpose in producing that representation or model was to evaluate and resolve uncertainty about the product (i.e., to obtain unavailable information necessary to establish capability, method, or appropriate design). Treas. Reg. § 1.174-2(a)(1), (4); *cf. Natkunanathan v. Commissioner*, T.C. Memo. 2010-15, 99 T.C.M. (CCH) 1071, 1074 ("Expenditures made to develop and deliver functional products for use by customers do not usually constitute 'research and development * * * in the experimental or laboratory sense.'"), *aff'd*, 479 F. App'x 775 (9th Cir. 2012). Petitioners have failed to make such a showing.

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[27] We typically treat a failure to adequately argue a point on brief as a concession. *See Petzoldt v. Commissioner*, 92 T.C. 661, 683 (1989); *see also Mendes*, 121 T.C. 308 at 312–13 ("If an argument is not pursued on brief, we may conclude that it has been abandoned.").

[*74] Instead, we conclude that the various projects were not "representation[s] or model[s]" as a whole and that CPI's purpose in incurring their production costs was not to evaluate and resolve uncertainty. First, any suggestion that CPI's various subcontractors and suppliers were constructing or supplying representations or models is wholly unsupported by the record. A representation or a model is generally defined as an accurate stand-in for something else. *Representation*, *Oxford English Dictionary* (3d ed. 2009), https://www.oed.com/view/Entry/162997 (last updated March 2023) ("Something which stands for or denotes another symbolically . . . ."); *Model*, *Oxford English Dictionary* (3d ed. 2002), https://www.oed.com/view/Entry/120577 (last updated December 2022) ("Something which accurately resembles or represents something else, esp. on a small scale . . . ."); *accord Representation*, *Webster's New World College Dictionary* (5th ed. 2016) (defining in relevant part as "a likeness, image, picture, etc."); *Model*, *Webster's New World College Dictionary* (5th ed. 2016) ("[A] preliminary representation of something, serving as the plan from which the final, usually larger, object is to be constructed . . . ."). The subcontractors and suppliers were not constructing representations or models that stood in for the final product in discovering information about whether a design was appropriate; instead, they were constructing the final product itself. *See Little Sandy Coal Co.*, T.C. Memo. 2021-15, at *42–43 (observing that example in regulations "draws a distinction between a model of a product and the product itself" (citing Treas. Reg. § 1.174-2(a)(11) (example 3))).

CPI's process confirms the proposition. If the oxidizers were pilot models, one might expect CPI to have conducted early-stage "testing to determine if the design of the product [was] appropriate" and then to have modified the design as necessary. Treas. Reg. § 1.174-2(a)(7), (11) (example 3). However, the record demonstrates that testing of the oxidizers as a whole occurred either at the subcontractor's facility before shipping or at the customer's facility after installation. At this late stage, CPI's design drawings were typically finalized, having already incorporated revisions earlier in the project in response to feedback from the customer and/or the subcontractors. Further, by the time testing occurred, CPI had incurred tens (sometimes hundreds) of thousands of dollars of costs in ordering specially sized components, in reliance upon the design drawings. If CPI still lacked information as to the appropriate design of each oxidizer *as a whole* (i.e., the oxidizer's basic design specification), incurring such costs would have been economically irrational in the extreme. *See Little Sandy Coal Co.*, T.C. Memo.

[*75] 2021-15, at *35 (observing that any defects found in late-stage, postconstruction testing would not have caused taxpayer to "scrap" the entire project and start over); Treas. Reg. § 1.174-2(a)(11) (example 4). We do not accept the circular argument that CPI incurred the substantial costs of implementing its designs with the purpose of discovering information about whether those designs as a whole were appropriate. We conclude that the claimed supply QREs incurred in the actual production of the oxidizers were not deductible under section 174. Having failed the section 174 test, these costs were not "incurred for supplies used in the conduct of qualified research" and thus are not creditable QREs. *See* § 41(b)(2)(A)(ii).

This conclusion would not necessarily mean the end of the inquiry. As noted above, the section 174 regulations provide a shrinking-back rule, which would instruct us to next analyze whether any particular components or subcomponents of the oxidizer systems were pilot models, discretely constructed with the purpose of evaluating and resolving uncertainty. *See* Treas. Reg. § 1.174-2(a)(5). However, petitioners have failed to carry their burden of establishing that any particular components or subcomponents were pilot models. Consequently, we conclude that none of CPI's claimed supply costs are QREs, and we will partially sustain on this basis respondent's determination that petitioners are not entitled to a research credit.

3. *Wage QREs*

We now turn to the issue of whether the claimed wage QREs satisfy the section 174 test. As a category of expenditure, such wages are potentially deductible under section 174 if paid or incurred during the taxable year.[28] However, we must still determine whether the employee activities underlying the claimed wage QREs constituted "research and development" within the meaning of section 174. To recap, petitioners must show that (1) information was not available to CPI establishing the appropriate design of the oxidizers and (2) CPI undertook investigative activities intended to discover such information.

Respondent argues that CPI employees' activities were not intended to discover information that would eliminate uncertainty regarding the development of the systems. Respondent focuses on the

[28] For an accrual method taxpayer such as CPI, wages are generally incurred and taken into account for the taxable year in which they are earned by the employee providing services. *See* § 461(h)(2)(A)(i); *see also Burlington N. R.R. Co. v. Commissioner*, 82 T.C. 143, 148 (1984).

[*76] fact that CPI had extensive experience in supplying commercially viable oxidizer systems to customers and had developed substantial industry-specific knowledge before 2014. Respondent also notes that CPI guaranteed the performance of its systems to customers and never failed such a guarantee; respondent thus suggests that CPI did not lack information with respect to the appropriate design of its systems.[29]

Petitioners counter that CPI faced uncertainty as to the appropriate design of each system even beyond the initial starting point of each system's commercial production, because the appropriate design of each system could not be established until after that system cleared various onsite tests. Petitioners suggest that uncertainty existed, because "[i]n all of these projects, the prospect of revising or altering the design of the overall system existed." Petitioners also point to several projects where the oxidizer supplied by CPI failed postinstallation testing and argue that "the appropriate design was not determined until after the design failed onsite testing."

The parties thus dispute whether CPI was uncertain as to the appropriate design for all 19 projects. At the outset, we must reject petitioners' blanket assertions that uncertainty existed with respect to the products as a whole simply because of the mere "prospect of revising or altering the design" before completion of onsite testing. The applicable regulations distinguish between objective uncertainty as to the design of a product as a whole (i.e., its basic design specification) and objective uncertainty as to the design of a particular component or subcomponent. *See* Treas. Reg. § 1.174-2(a)(5). As alluded to above, conducting postproduction testing on a product does not establish that its appropriate design as a whole "remained uncertain before those tests were successfully completed." *Little Sandy Coal Co.*, T.C. Memo. 2021-15, at *53. Any failure of an oxidizer system to pass testing might have resulted in some additional information-discovering activities with respect to a redesign of a particular component or subcomponent (with corresponding wage QREs then being potentially creditable) but would not have required CPI "to scrap the entire [oxidizer] and start afresh." *See id.*

Our determination of whether the activities underlying the wage QREs satisfied the section 174 test must necessarily be more granular, examining the activities of CPI employees. The parties did not agree to

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[29] The record supports respondent's factual contention that CPI ultimately satisfied the provided performance guarantees for all 19 projects.

[*77] a sample of CPI's projects for 2014, thus placing at issue all 19 projects for which CPI claimed the research credit.[30] *See* § 41(d)(2)(A); *cf. Little Sandy Coal Co.*, T.C. Memo. 2021-15, at *3, *20 (effecting parties' agreement to select only 4 of 11 projects as samples). We thus must determine whether the wage QREs associated with each project satisfied the section 174 test, at the level of both the projects as a whole and particular subcomponents that petitioners identified at trial.[31]

a. *3M Hutchinson (#13-07520)*

This project involved CPI's design and supply of a 30,000 SCFM regenerative thermal oxidizer for a 3M facility that manufactured sticky notes. Petitioners suggest that CPI was uncertain as to the appropriate design for the 3M Hutchinson project as a whole until the oxidizer passed onsite testing. Petitioners emphasize that this was the first regenerative thermal oxidizer designed by CPI.

Petitioners' argument overlooks key facts. CPI submitted its final, revised proposal to 3M on August 30, 2013, and 3M accepted the proposal via a purchase order issued on September 3, 2013. Acceptance of the proposal by 3M was a key date in the development of the basic design of the oxidizer. The proposal, which relied upon and addressed a detailed set of specifications provided by 3M, demonstrated that CPI already had considerable information available to it with respect to the appropriate design. For instance, the proposal observed that the exhaust from the Hutchinson facility "is understood to come from the 2L Coating Line at a volume of 18,000–25,000 SCFM at 125 F to 175 F and contains a combination of methanol, ethyl acetate, IPA, toluene, and other common solvents at loadings of 245–1750 lb/hr." The proposal further provided for a 99% destruction efficiency performance

[30] Absent an agreement between the parties, project sampling improperly relieves the taxpayer of its burden of proving entitlement to the research credit claimed. *See Bayer Corp. v. United States*, 850 F. Supp. 2d 522, 538, 545–46 (W.D. Pa. 2012).

[31] Petitioners allocated wage QREs project by project and did not further allege or brief the amounts of wage QREs relating to specific components or subcomponents; given petitioners' "all or nothing" litigation strategy on this point, we could decline to go deeper than the level of the 19 projects as a whole. *Cf. Little Sandy Coal Co. v. Commissioner*, 62 F.4th at 303 (affirming this Court's decision not to apply shrinking-back rule where taxpayer failed to document research activities corresponding to project subcomponents). However, the trial testimony in this case addressed particular components and subcomponents on some of the projects, and, for the sake of completeness, we believe it appropriate to perform a shrinking-back rule inquiry, to the extent the limited record allows us to do so.

[*78] guarantee. As Mr. Harmsen later testified: "The majority of the [3M Hutchinson] oxidizer design was decided upon with the 99 percent destruction efficiency and the air flow rate and the VOCs that [we] are talking about." Further bearing this out, CPI prepared initial general arrangement and P&ID drawings for the oxidizer soon after acceptance of the proposal, in October 2013. While minor revisions were subsequently made to those drawings in late 2013 and 2014, the basic design specification of the oxidizer did not change as a result of those revisions.[32] We find that information available to CPI in 2013 established the appropriate design of the oxidizer as a whole.

Consequently, corresponding wage expenditures for any theoretical investigative activities with respect to the oxidizer as a whole would have been incurred in 2013, rather than 2014, the taxable year at issue. *See* § 174(a)(1) (requiring that expenditures be "paid or incurred . . . during the taxable year"), § 41(b)(1). We conclude that the appropriate design of the oxidizer as a whole had already been established by information gathered in 2013; thus the product as a whole fails the section 174 test. We look next to whether the shrinking-back rule is applicable with respect to particular components or subcomponents.

At trial, Mr. Harmsen identified a number of further "difficulties" that CPI encountered "during the design and development" of the 3M Hutchinson project, some of which related to particular components of the oxidizer design. These identified difficulties included (1) 3M's preference for an induced draft fan; (2) 3M's preference for a two-burner system; and (3) 3M's discovery of discrepancies in the electrical design. With respect to the induced draft fan, CPI already had extensive specifications provided by 3M that provided information about the necessary fan design. In July 2013 Mr. Harmsen used those specifications to initially calculate the size of the fan as 23 inches. The final proposal then further detailed key elements of fan design, including the horsepower, temperature rating, and arrangement of the fan. In December 2013 CPI then provided that information to a fan supplier, AirPro, which provided design drawings for a 300 horsepower booster fan component. Those design drawings were then incorporated into the final oxidizer design. The record is unclear as to (1) what

[32] When prompted at trial to describe what subsequent changes were made to the design, Mr. Harmsen described (1) the addition of a walkway to the front of the oxidizer, (2) moving the gas trains to the back of the oxidizer, and (3) adding crane davits in order to lift components off the oxidizer.

[*79] additional, unavailable information CPI needed to determine the appropriate fan design and (2) what investigative activities particular CPI employees undertook in 2014.

With respect to the two-burner feature, CPI similarly already had extensive specifications provided by 3M, specifying the brand of burner to be used and various operational requirements. Mr. Harmsen further testified that the particular burner size was determined by 3M's choice of brand (Maxon Kinemax). In February 2014 CPI purchased two four-inch Kinemax burners to be shipped to Pre-Heat. Petitioners did not produce further evidence establishing (1) what additional, unavailable information CPI needed to determine the appropriate design of the burners and (2) what investigative activities particular CPI employees undertook with respect to the burners in 2014. *Cf. Union Carbide Corp.*, 97 T.C.M. (CCH) at 1261 (finding no uncertainty as to appropriate design where manufacturer designed and supplied component and taxpayer presented no evidence of adaptation).

Finally, with respect to the change in the electrical components, we find that CPI employees did not perform any investigative activities that would constitute research and development. To the contrary, Mr. Harmsen's testimony established that 3M's electrical engineer simply noticed certain discrepancies where the design drawings differed from the specifications and requested specific changes. In response, CPI directed Quantum Design to make those changes. At the shrunk-back component level, we conclude that petitioners have failed to satisfy the section 174 test.

We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the 3M Hutchinson project.

b. *Akzo Nobel (#13-07645)*

This project involved CPI's design and supply of a 6,000 SCFM regenerative thermal oxidizer for an industrial paint manufacturer. CPI's final proposal was accepted in December 2013. Consequently, as with 3M Hutchinson, any theoretical investigative activities performed by CPI before submission of the final proposal corresponded to wage QREs that were not incurred in tax year 2014. Given that the proposal memorialized many of the already-determined basic design considerations and specifications (e.g., type of oxidizer, airflow volume, VOCs at issue), we conclude that any objective uncertainty as to the

[*80] design of the oxidizer as a whole was resolved before 2014, and thus petitioners have failed to satisfy the section 174 test.

In contrast, petitioners have established that they performed some investigative activities in 2014 at the shrunk-back component level. Namely, Mr. Harmsen and J.O.'s meeting with Akzo Nobel personnel in February 2014 appears to constitute research and development within the meaning of the section 174 regulations. Mr. Harmsen documented that meeting in contemporaneous notes, which demonstrate that he and J.O. elicited further information and specifications from Akzo Nobel about necessary design features for oxidizer components, particularly the flame arrestor component. However, allocating an estimated amount of wages to the activities of Messrs. Harmsen and J.O., pursuant to the *Cohan* rule, would be futile, because we alternatively hold that the activities performed on the Akzo Nobel project were not part of a process of experimentation, as required by section 41(d)(1)(C). *See Union Carbide Corp.*, 97 T.C.M. (CCH) at 1256 (observing that process of experimentation test "requires the use of the scientific method" and "imposes a more structured method of discovering information than section 174"); Treas. Reg. § 1.41-4(a)(5)(i) (setting out process of experimentation test's requirements); *see also Eustace v. Commissioner*, 312 F.3d at 907 ("Experimentation is a subset of all steps taken to resolve uncertainty; otherwise searching for a place to park a car would be a 'process of experimentation'."). We thus more broadly conclude that CPI's activity with respect to the flame arrestor component did not constitute qualified services.

Further, petitioners have failed to demonstrate any additional investigative activities that CPI personnel performed to resolve design uncertainty with respect to the flame arrestor or any other shrunk-back components of the oxidizer. We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the Akzo Nobel project.

c. *HA International (#13-07615)*

This project involved CPI's design and supply of two 13,700 SCFM recuperative thermal oxidizers for a manufacturer of fracking sand. At trial Mr. Betz identified several potential uncertainties as to the appropriate design of the oxidizers as a whole, including the potential for phenolic resin buildup and the presence of water and sand particulates in the process airflow.

[*81] However, the record demonstrates that by November 6, 2013, when CPI delivered to HAI a final proposal for the oxidizers, CPI had extensive information available to it that established the appropriate design of the oxidizer as a whole. In early 2013 CPI personnel had visited HAI's facility and had received emissions testing information as to the facility's air exhaust. That testing informed CPI of the airflow volume at the facility and the particular VOCs at issue, both of which dictated the basic design specification of the oxidizer. *Cf. Siemer Milling Co. v. Commissioner*, T.C. Memo. 2019-37, at *33–34 (concluding that project failed section 174 test where taxpayer already had prior year testing information resolving uncertainty). CPI also had extensive generalized information available to it as to the appropriate design of a system that dealt with sand particulate. As its proposal to HAI stated, CPI had previously designed "+30 units in the sand resin coating industry" and was highly experienced in dealing with the sand particulate issue. *Cf. Max*, T.C. Memo. 2021-37, at *33 (concluding that section 174 test was not satisfied where taxpayer regularly encountered the claimed uncertainty in past and had developed standardized solutions to it). To resolve the sand issue, CPI included in the November 2013 proposal hinged access doors to allow HAI to periodically clear sand out of the bottom of the combustion chamber. We conclude that objective uncertainty did not exist with respect to the appropriate design of an oxidizer as a whole that could satisfy the customer's needs and resolve the sand particulate issue. *See Union Carbide Corp.*, 97 T.C.M. at 1262 (looking to taxpayer's "significant experience" in previously using component to resolve issue and finding no uncertainty under section 174).

The November 2013 proposal similarly addressed other "uncertainties" as to the appropriate design identified by Mr. Betz. The proposal stated that the oxidizer would include a "direct fired duct heater system" that was "designed to help reduce both water and resin build up prior to" the oxidizers. At trial Mr. Shaver credibly testified that CPI had encountered the resin buildup issue before 2014 and had previously developed this particular design solution. We find that information was available to CPI establishing the appropriate design of the oxidizer as a whole during the proposal stage, before 2014.

We next look to the shrinking-back rule. At trial Mr. Betz discussed space constraints at the HAI facility, which required that the high horsepower booster fan be placed close to the oxidizer. That proximity posed problems, as the air from the fan would come out in a high-velocity jet aimed at the center of the oxidizer's heat exchanger,

[*82] degrading the heat exchanger's performance and running the risk of pipe components' burning up because of a lack of cooling airflow. Mr. Betz testified that CPI addressed this issue by including baffles and deflection plates in the design, both of which are components that can dissipate and redirect airflow. Even assuming arguendo that this implicated objective uncertainty, petitioners failed to establish that investigative activities were performed by CPI employees in 2014 with respect to the fan/baffle sheet components.[33]

Mr. Betz also identified a pair of issues with components that emerged during postinstallation testing. First, a quality audit performed by L.S. on the oxidizer, as installed at HAI's facility in 2014, revealed that several tubes in the heat exchanger had overheated because of inadequate airflow and broken free from the heat exchanger.[34] CPI replaced and rewelded the tubes and then installed a different air splitting component (a turning vane) that more evenly dispersed air throughout the heat exchanger. The second issue that emerged during postinstallation testing was ruptured pressure release valves from excess vibration. CPI resolved the issue by cutting down the length of the damper blades.

The decisions to add the turning vane and cut down the damper blades may well have implicated objective uncertainty and investigative activities. However, on the record before us, we are unable to bridge the vast evidentiary gap petitioners left. Aside from Mr. Betz's vague testimony, petitioners' failure to produce evidence as to what investigative activities were performed with respect to the turning vane and damper blades prevents us from applying the shrinking-back rule. *See Eustace*, 81 T.C.M. (CCH) at 1374; *Trinity Indus., Inc.*, 691 F. Supp. 2d at 693; *see also United States v. Davenport*, 897 F. Supp. 2d 496, 517–18 (N.D. Tex. 2012) (declining to apply shrinking-back rule and concluding that "even if the court had concluded that some of the expenses claimed" were for qualified research, taxpayers failed to

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[33] We note that the project proposal (finalized in 2013) stated that baffle sheets would be included in the oxidizer, thus suggesting that information was already available to CPI with respect to this component before 2014.

[34] We note that any wage expenditures incurred in connection with conducting the quality audit would appear to be for quality control testing and thus would fail to satisfy the section 174 test. *See* Treas. Reg. § 1.174-2(a)(6)(i), (7) (providing that section 174 deduction is not available with respect to expenditures for "testing or inspection to determine whether particular units of materials or products conform to specified parameters"). Petitioners fail to identify how much (if any) of L.S.'s wage QREs correspond to this testing.

[*83] provide evidence tying costs to specific subcomponents). Even if petitioners had established that activities performed with respect to these two components satisfied the section 174 test, they also failed to identify the activity-performing CPI employees and thus did not provide a reasonable basis for estimating the amount of corresponding wage QREs. *See Eustace*, 81 T.C.M. (CCH) at 1374 (declining to apply the *Cohan* rule where taxpayers failed to substantiate employee's wages at subcomponent level); *see also Shami v. Commissioner*, 741 F.3d at 569 ("[T]he Tax Court was entitled to decline to make an estimate if it found that [the taxpayers] had not provided a reasonable basis on which to make one."). We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the HAI project.

d. *3M Hartford (#13-07611)*

This project involved CPI's design and supply of a 25,000 SCFM recuperative thermal oxidizer for a 3M facility that manufactured tape. The final proposal for the project was accepted by 3M in 2013. As with the 3M Hutchinson project, the final project proposal incorporated and addressed detailed specifications provided by 3M and thus demonstrated that considerable information was already available to CPI with respect to the appropriate design of the oxidizer as a whole.

In addition, with respect to the 3M Hartford project as a whole, petitioners argued on brief that "CPI developed proprietary technology to design this silicone oxidizer with vertical tubes and a larger heat exchanger." Petitioners failed to mention that this proprietary, industry-specific technology—its Quadrant SRS Silicone series—had been developed by CPI, in the words of Mr. Harmsen, over a period of "close to 20 years." Consequently, CPI had a plethora of information available to it with respect to the basic design specification of an oxidizer that worked well in the presence of silicone dioxide. The vertical orientation of the oxidizer, which petitioners identified as a key design feature addressing silicon dioxide, was well understood by CPI and had been used by CPI in designs for many years before 2014. We find that information was available to CPI establishing the appropriate design of the oxidizer as a whole in 2013, before tax year 2014.

At the shrunk-back component level, Mr. Harmsen identified a design change made to the recirculation duct component; he testified that 3M provided CPI with more precise specifications about the process airflow, which CPI was able to use to make the duct component smaller

[*84] at 3M's request. The record demonstrates that Mr. Harmsen performed basic calculations to determine the duct size that were based on the revised airflow specifications provided by 3M. The basic calculations performed by Mr. Harmsen were not investigative activities within the meaning of the section 174 regulations. *See Max*, T.C. Memo. 2021-37, at *30 (finding that information was subjectively unknown to taxpayer with respect to appropriate sizing of component but concluding that the taxpayer "already ha[d] the information necessary to address that unknown"); *see also Little Sandy Coal Co. v. Commissioner*, 62 F.4th at 298 (characterizing a sizing question as implicating only generic construction uncertainty). Petitioners did not produce additional credible evidence as to what investigative activities were performed with respect to the duct component.

With respect to the burner and gas train components, Mr. Harmsen also identified an instance where 3M requested that CPI determine whether the oxidizer could run the process combustion air as fuel for the burner. CPI input the provided specifications into standardized spreadsheets, which output the estimated fuel costs and sizes for a burner that used either combustion air or raw gas. Mr. Harmsen testified that CPI ultimately determined that using the combustion air would be countereffective, as the silicone dioxide byproduct would plug the burner. However, the record establishes that, to the extent uncertainty may have existed with respect to this issue, it was resolved in 2013, before the tax year at issue. The final project proposal, which was accepted by 3M in November 2013, contained footnotes in the sections discussing the burner and gas train components, stating: "Burner system changed to raw gas, 11/12/13" and "Combustion air eliminated and Gas train modified to accommodate raw gas burner, 11/12/13." Petitioners have thus failed to establish that uncertainty existed in 2014 with respect to the burner and gas train components designs.

Finally, in June 2014 3M and CPI executed a scope change to the project proposal, replacing the proposed backward inclined blade style fan with a radial blade style fan. Again, however, petitioners did not produce evidence of what investigative activities were performed by CPI employees with respect to any uncertainty. To the contrary, Mr. Harmsen testified that 3M personnel instigated the change because of their concerns about how the fan would handle particulates.

[*85] We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the 3M Hartford project.

e. *C&D Zodiac (#13-07583)*

This project involved CPI's design and supply of a 9,400 SCFM regenerative thermal oxidizer for an aircraft composite manufacturer. CPI's final proposal for the project was accepted by C&D Zodiac in October 2013. The record establishes that, as of October 2013, when CPI tendered its final project proposal to C&D Zodiac, CPI had the necessary information with respect to the appropriate design of the product as a whole. In October 2013 CPI obtained detailed measurements and calculations from the process airflow, which Mr. Harmsen was able to use to make determinations about the oxidizer size and the necessity of additional features. After acceptance of the final proposal, in November 2013, C&D Zodiac provided some additional information to CPI that necessitated minor changes to the design. We conclude that any objective uncertainty was resolved in 2013, rather than 2014.

At the shrunk-back component level, petitioners failed to establish that investigative activities were performed in 2014. Mr. Harmsen identified an instance where CPI moved the location of thermocouples on the oxidizer from the top of the oxidizer to its back wall.[35] The record contains only a rough handwritten drawing of the new location, made by J.O. in February 2014. Neither the drawing nor Mr. Harmsen's vague testimony established what investigative activities CPI performed with respect to the thermocouples.

We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the C&D Zodiac project.

f. *Teva (#14-07808)*

This project involved CPI's design and supply of a 1,500 SCFM regenerative thermal oxidizer for a pharmaceutical pill manufacturer. Petitioners presented comparatively little trial testimony with respect to CPI's work on the Teva project. Petitioners presented some photographic evidence and testimony about dye penetrant testing

[35] A thermocouple is a device that measures temperature inside an oxidizer.

[*86] conducted on the oxidizer. Mr. Betz characterized that testing as intended to confirm that the subcontractor's assembly was "being made as per our drawings." Taking that uncontroverted testimony as credible, the purpose of the testing was thus to determine whether the oxidizer, as fabricated and assembled, conformed to the design, not to determine whether the design itself was appropriate. *See Max*, T.C. Memo. 2021-37, at *35 (concluding that testing conducted to determine whether components met taxpayer's "established parameters" for product was excluded quality control testing); *Natkunanathan*, 99 T.C.M. (CCH) at 1074 (observing that any testing conducted by taxpayer to "ensure compliance with customer specifications" was excluded quality control testing). We find that the dye testing constituted excluded quality control testing, not research and development within the meaning of the section 174 regulations.[36] *See* Treas. Reg. § 1.174-2(a)(7) ("[T]esting or inspection to determine whether particular units of materials or products conform to specified parameters is quality control testing.").

We now turn to petitioners' evidence relating to shrunk-back components of the design. Mr. Betz identified the site-specific requirement that the oxidizer transmit no more than a "certain amount of vibration" to Teva's pharmaceutical facility. Petitioners produced photographs of vibration spring components that were installed on the oxidizer to mitigate this concern.[37] However, petitioners did not produce further evidence establishing what investigative activities were performed by particular CPI employees with respect to the spring components. Merely identifying a project difficulty and the eventual design solution, without bridging the gap with evidence as to what investigative activities were performed, does not satisfy petitioners' burden.

Mr. Betz also discussed an issue where postinstallation testing showed that the heat exchanger was preheating the airflow at too high a level, a flaw which CPI corrected by modifying the control system to introduce fresh diluting air. Again, however, petitioners did not establish what investigative activities were performed by particular CPI employees with respect to the heat exchanger. We conclude that

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[36] Even if the testing were research and development within the meaning of the section 174 regulations, we would still conclude that petitioners have failed to provide a reasonable basis for the Court to apply the *Cohan* rule, given the absence of evidence in the record as to which particular CPI employees conducted the testing.

[37] The record is unclear as to when the vibration spring components were installed.

[*87] petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the Teva project.

g. *Mitsubishi (#14-07899)*

This project involved CPI's design and supply of a 35,000 SCFM regenerative thermal oxidizer. Petitioners suggest that CPI personnel conducted investigative activities in calculating the various component sizes of the oxidizer. We again reject their assertion. CPI already had the necessary information, from both the customer and CPI's own existing knowledge of the facility (where it had previously installed a catalytic oxidizer), to determine the basic design specification of the oxidizer as a whole. *See Max*, T.C. Memo. 2021-37, at *30–31 (finding that taxpayer already had information necessary to determine appropriate size of design element before performing iterative size testing). Mr. Harmsen then used that information to perform basic calculations for components, both by hand and by inputting it into a computer spreadsheet. As noted above, performing simple calculations on already-available information or data does not itself constitute an investigative activity within the meaning of the section 174 regulations. *Cf. id.* at *31. Petitioners have not established that CPI employees undertook investigative activities with respect to the design of the oxidizer as a whole.

We next look to the shrinking-back rule. At trial Mr. Harmsen testified that the oxidizer's poppet valve went out of alignment and came unscrewed. Mr. Harmsen testified that CPI initially addressed the issue by temporarily welding connections, before eventually replacing the valve and shaft system completely. Such activities do not appear to be research and development within the meaning of the section 174 regulations. *See Siemer Milling Co.*, T.C. Memo. 2019-37, at *33 (concluding that section 174 test was not satisfied by activities "more akin to mechanical maintenance"). Further, Mr. Harmsen did not address in his testimony (1) when the valve issue was discovered; (2) which CPI employees performed activities; or (3) whether any activities were investigative. Mr. Harmsen's testimony was the primary evidence that petitioner produced regarding the valve issue. Even if petitioners had established that the valve component satisfied the section 174 test, petitioners nonetheless have not provided a reasonable basis for the Court to estimate the amount of creditable wage QREs. *See Shami v. Commissioner*, 741 F.3d at 569 (affirming this Court's decision not to apply *Cohan* where taxpayer failed to produce reasonable evidentiary

[*88] basis for estimate). We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the Mitsubishi project.

h. *3M Monrovia (#14-07784)*

This project involved CPI's design and supply of a 12,000 SCFM recuperative thermal oxidizer. Petitioners did not present credible evidence establishing uncertainty as to the design of the oxidizer as a whole (i.e., the basic design specification). To the contrary, Mr. Harmsen testified to the following:

> 3M has a good idea of what their process can do. So they know their VOCs, they know their ranges very well. They know the extent of their equipment they used to buy to make this thing. So they know what their design criteria needs to be, that doesn't get iterated very much.

Mr. Harmsen's characterization of the basis of design accords with the record, particularly with the extensive design specifications that 3M provided to CPI at the outset of the project. We find that the information provided by 3M established the design of the oxidizer as a whole.

With respect to shrunk-back components, Mr. Harmsen described the 3M Monrovia design as using a unique particulate-capturing device that would intake airflow during the startup and shutdown phases of the system to capture silicone dust and silicone dioxide. Mr. Harmsen noted that the idea for the particulate-capturing device was jointly conceived by himself and personnel from 3M. However, Mr. Harmsen did not elaborate on what investigative activities were performed to determine the design of the particulate-capturing device.

Mr. Harmsen further testified that, on account of California environmental regulations with respect to nitrogen oxides and carbon monoxides, the burner system (and its fuel emissions) was the design's "driving factor." Mr. Harmsen testified that CPI personnel talked to Maxon about the requirements for a low nitrous oxide burner, which was then incorporated into the design. Discussions with Maxon representatives might well have involved investigative activities within

[*89] the meaning of the section 174 regulations.[38] Once again, however, petitioners failed to elaborate as to which particular CPI employees were involved with respect to the burner and its fuel emissions.

Petitioners did not establish that particular CPI employees performed investigative activities with respect to any other shrunk-back components of the oxidizer. We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the 3M Monrovia project.

i. *Celanese (#14-07852)*

This project involved CPI's design and supply of a 20,000 SCFM regenerative thermal oxidizer. In December 2013 the engineering firm engaged by Celanese, WorleyParsons, provided CPI with extensive design specifications and requirements. That information in turn dictated the basic design specification of the oxidizer. We thus conclude that CPI did not undertake investigative activities with respect to the oxidizer as a whole. We now turn to the question of whether the section 174 test was satisfied at the shrunk-back component level.

At trial Mr. Harmsen identified the cold temperatures at the Edmonton facility as a design difficulty.[39] With respect to the cold temperatures, petitioners established that objective uncertainty existed as to how to design the gas train component. The record contains an email from Mr. Betz to a Maxon representative asking about how to meet Celanese's cold temperature specifications in designing the gas train. We further find that Mr. Betz's email activity was an investigative activity within the meaning of the section 174 regulations. *See* Treas. Reg. § 1.174-2(a)(1). However, allocating a de minimis, estimated amount of wages to Mr. Betz's email activity, pursuant to the *Cohan* rule, would be futile; we alternatively hold that Mr. Betz's email

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[38] However, such activities would likely not satisfy the process of experimentation test. *See Siemer Milling Co.*, T.C. Memo. 2019-37, at *24 (citing Treas. Reg. § 1.41-4(a)(8) (example 5) ("[E]valuation of products available from vendors is not a process of experimentation.")).

[39] Mr. Harmsen also vaguely alluded to difficulties relating to Canadian building code and product standards, which the record suggests may have involved whether the control house was subject to building code standards. Petitioners did not establish (1) what information was unavailable to CPI with respect to the Canadian rules, nor (2) what investigative activities were undertaken by CPI employees with respect to those rules.

[*90] activity was not part of a structured process of experimentation and thus fails to clear the higher bar of section 41(d)(1)(C). *See Siemer Milling Co.*, T.C. Memo. 2019-37, at *36 (describing taxpayer's testing of third-party product "more akin to evaluating available products on the market . . . than a true process of experimentation"); *Union Carbide Corp.*, 97 T.C.M. (CCH) at 1256 (observing that process of experimentation test "requires the use of the scientific method" and "imposes a more structured method of discovering information than section 174"); *see also Eustace v. Commissioner*, 312 F.3d at 907. We thus more broadly conclude that petitioners did not carry their burden of establishing that CPI's activity with respect to the gas train component constituted qualified services.

Petitioners have failed to demonstrate any additional investigative activities that CPI personnel performed with respect to the gas train or other shrunk-back components of the oxidizer. We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the Celanese project.

j. *Smalley (#14-07658)*

This project involved CPI's design and supply of an 800 SCFM direct thermal oxidizer for an aircraft engine fastener manufacturer. The Smalley project involved the customer's concern about preventing visible smoke emissions, rather than eliminating particular VOCs. Because this objective was unusual for CPI, CPI did not have information available as to what temperatures would cause emissions to be visible in the process airflow. To gather that information, CPI conducted simulation testing at the Smalley facility in 2014, using steel samples coated with the facility's condensation byproduct, which were then placed in a furnace at the Smalley facility. By setting the furnace to particular temperatures, CPI personnel were able to observe when smoke emissions from the condensation were present. Using the testing results, CPI personnel then programmed the oxidizer's control system to automatically turn the burner on and off according to whether the facility's furnaces were operating at the observed temperatures that had created visible smoke. We find that this testing constituted research and development within the meaning of the section 174 regulations.[40] *See* Treas. Reg. § 1.174-2(a)(1) ("[A]ctivities [must be] intended to

[40] We note that programming of the control system itself was not an investigative activity within the meaning of the section 174 regulations.

[*91] discover information that would eliminate uncertainty concerning the development or improvement of a product.")

However, assuming arguendo that the testing would satisfy the process of experimentation test, petitioners did not produce evidence sufficient to provide the Court with a reasonable basis to approximate the wage QREs corresponding to these activities, pursuant to the *Cohan* rule. Petitioners did not produce any evidence as to which employees performed the testing, leaving a potential *Cohan* rule estimate as little more than a stab in the dark. *See Shami v. Commissioner*, 741 F.3d at 568 (observing that applying *Cohan* rule to an employee's wage QREs requires a threshold showing by taxpayer that "its employee performed some qualified services"); *Moore*, T.C. Memo. 2023-20, at *10–11; *CRA Holdings US, Inc. v. United States*, No. 15-CV-239, 2018 WL 4001675, at *8 (W.D.N.Y. Aug. 22, 2018) (concluding that *Cohan* rule was inapplicable in discovery where taxpayer failed to provide "specific information to document the actual time [the taxpayer's employees] spent in performing qualified services"); *see also Coors Porcelain Co.*, 52 T.C. at 698 (observing that taxpayer's failure to produce evidence rendered it "impossible" to differentiate section 174 research expenditures from nondeductible costs). We see no reason petitioners could not have elicited testimony from their trial witnesses on this point. *See Buelow v. Commissioner*, 970 F.2d at 415; *Kollsman Instrument Corp.*, 51 T.C.M (CCH) at 467 (declining to apply *Cohan* rule where taxpayer was unable to present trial witnesses knowledgeable about the expenses at issue). We thus decline to excuse petitioners' failure to do the necessary evidentiary spadework before trial.

In addition, Mr. Betz identified a design difficulty due to the oxidizer's proposed location in the middle of the Smalley facility building; because of that location, a fan could not be used to blow process airflow into the oxidizer. Accordingly, CPI determined to use a vertical combustion chamber that would allow hot air to naturally rise through the oxidizer. However, the record establishes that CPI had determined the basic design specification of the vertical oxidizer before submitting a project proposal to Smalley in late 2013. That project proposal described the vertical combustor process at length and provided sizes for its components. We conclude that any investigative activities were performed in 2013 and thus do not satisfy the section 174 test in 2014.

At the shrunk-back component level, petitioners did not establish that investigative activities were performed in 2014 by CPI employees. We conclude that petitioners have failed to carry their burden of

[*92] establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the Smalley project.[41]

k. *Isola I (#14-07607)*

This project involved CPI's design and supply of several replacement parts for an existing 7,000 SCFCM recuperative thermal oxidizer. Petitioners also spent relatively little trial testimony discussing this project. The record demonstrates that CPI had extensive information available to it as to the appropriate design of those parts by the time the final revised proposal was accepted by Isola on November 12, 2013. Most significantly, CPI had previously supplied the existing oxidizer at the Isola facility and thus had extensive information available with respect to its design. Petitioners failed to establish that particular CPI employees performed investigative activities with respect to the design of the replacement parts. We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the Isola I project.

l. *Isola II (#14-07890)*

This project involved CPI's design and supply of a 6,000 SCFM recuperative thermal oxidizer. As with Isola I, CPI already possessed extensive information about the Isola facility and its process airflow. Also as with Isola I, petitioners spent relatively little trial testimony addressing this project. Petitioners did not establish (1) that objective uncertainty existed as to the oxidizer as a whole or (2) what investigative activities particular CPI employees undertook to resolve any theoretical uncertainty.

We thus move on to the shrunk-back component level. At trial Mr. Betz identified a postinstallation issue with the control system component, where testing revealed that the system was pushing some hot air out of the ovens. However, the record bears out that this was ordinary testing for quality control and thus not research and development. *See* Treas. Reg. § 1.174-2(a)(7). While CPI did modify the

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[41] Alternatively, we hold that petitioners failed to carry their burden of establishing that the testing was part of a methodical plan that constituted a process of experimentation. *Cf. Siemer Milling Co.*, T.C. Memo. 2019-37, at *9–10, *38 (concluding that taxpayer's heat treating of grain samples at "varying times and temperatures" to determine functionality lacked a hypothesis and "methodical plan" and thus was not part of a process of experimentation).

[*93] control system after discovering the air pressure issue, petitioners have failed to establish that testing itself was intended to gather information about the appropriate design of the oxidizer, rather than to simply test whether the system conformed to the design and met quality standards. *See id.* para. (a). Similarly, petitioners have failed to demonstrate what investigative activities CPI employees performed after the testing to determine the necessary modifications to the control system's sequence of operations.

In addition, Mr. Betz's trial testimony did not establish that further investigative activities were performed with respect to any other shrunk-back component of the oxidizer. We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the Isola II project.

m. *Goodyear Lawton (#14-07925)*

This project involved CPI's design and supply of a 50,000 SCFM regenerative thermal oxidizer. Petitioners did not establish (1) that objective design uncertainty existed as to the oxidizer as a whole or (2) what investigative activities particular CPI employees undertook to resolve that uncertainty.

That leaves the shrinking-back rule. Petitioners suggest that CPI encountered "technical challenges with effectively distributing the temperature with only a single burner, creating proper seals on the poppet valves and strict shipping constraints." At trial, Mr. Harmsen similarly testified that CPI was "worried about distribution of temperature with a single burner inside of a combustion chamber" because of the large size of the oxidizer. We found Mr. Harmsen to lack credibility with respect to this contention at trial.[42] Mr. Harmsen did not testify as to (1) when that concern arose; (2) what information was unavailable with respect to the appropriate design of the burner component; or (3) what actions were taken by CPI employees to gather additional information for the design. The record is similarly silent on this point.

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[42] We note that, in contrast to Mr. Harmsen's characterization, the final project proposal stated that CPI's burner design "provides the high velocity which creates a tremendous amount of turbulence and leads to the excellent temperature uniformity for which TRITON RTO's are known," suggesting that information was already available to CPI with respect to a design that achieved temperature uniformity.

[*94] Next, Mr. Harmsen testified that CPI was concerned about getting the poppet valves to seal, because of their large size. Again, neither Mr. Harmsen's testimony nor the record establishes (1) when the concern arose; (2) what information was unavailable; and (3) what actions were taken by CPI employees to gather additional information.

Finally, Mr. Harmsen testified that the possibility of oversizing the oxidizer was a design challenge, as freight trucks might not be able to carry a too-wide oxidizer. We fail to see how this issue establishes that CPI lacked information as to the appropriate design of the oxidizer. To the contrary, Mr. Harmsen's testimony suggests that information was readily available to CPI with respect to the typical capacity of freight trucks, and CPI personnel simply kept this information in mind when determining the oxidizer's size.

We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the Goodyear Lawton project.

n. *Wenner (#14-0800)*

This project involved CPI's design and supply of a 3,000 SCFM catalytic oxidizer for an artisanal bread manufacturer. After contacting CPI, Wenner provided CPI with specifications about the airflow and ethanol quantities at its facility. CPI personnel then entered those specifications into a spreadsheet that provided heat release and LEL levels. Those outputs in turn dictated CPI's design choice to use a catalytic oxidizer, rather than a thermal one.

We thus agree with petitioners' suggestion that information was not initially available to CPI to establish the appropriate design of the oxidizer as a whole. However, we disagree that CPI undertook activities intended to discover such information. Wenner provided CPI with the key information and specifications, which were then entered into spreadsheets in a rote fashion. The output of the spreadsheets then dictated CPI's ensuing design choices. We conclude that petitioners have failed to carry their burden of establishing that the product as a whole satisfied the section 174 test. We look next to whether the shrinking-back rule is applicable.

At trial, Mr. Betz identified several design challenges that relate to components, including (1) the need to control high temperatures and (2) the concern that baking oils and fats would degrade the catalyst. With respect to the temperatures, CPI included an internal hot gas

[*95] bypass in the design, which avoided overheating the heat exchanger by outputting hot air directly from the catalyst bed to the stack. However, petitioners failed to establish (1) what information was unavailable to CPI with respect to the hot gas bypass or (2) what investigative activities were undertaken by CPI employees.

With respect to the baking oils and fats, CPI similarly included a catalyst guard in the design, which reacted to and vaporized the oils and fats before they encountered the catalyst itself. Again, however, petitioners failed to establish (1) what information was unavailable to CPI with respect to the hot gas bypass or (2) what investigative activities were undertaken by CPI employees.

We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the Wenner project.

o. *East Balt (#14-07950)*

This project involved CPI's design and supply of a 5,000 SCFM catalytic oxidizer for a hamburger bun manufacturer. Before submitting a project proposal, CPI personnel initially visited the East Balt facility to measure the airflows from the baking ovens. Absent the measurements concerning the airflows, information was not available to CPI establishing the appropriate design as a whole. As we have found, airflow volume and VOC concentrations were some of the considerations that dictated a project's basic design specification. In addition, we find that measuring these airflows was an investigative activity within the meaning of the section 174 regulations. However, even assuming that this activity also satisfied the process of experimentation test, petitioners' evidentiary imprecision would prevent us from applying the *Cohan* rule to estimate the amount of wages that corresponded to this activity; accordingly, petitioners have failed to establish which CPI employees performed the measuring activities.[43] *See Shami v. Commissioner*, 741 F.3d at 568.

[43] The closest petitioners came to providing a reasonable basis for applying the *Cohan* rule was Mr. Betz's testimony, where he repeatedly used the collective pronoun "we" with respect to the taking of the measurements. But as the Court had ample opportunity to observe at trial, Mr. Betz's frequent uses of "we" referred to CPI, rather than to himself and any other identifiable individuals. The record is entirely silent as to which employees performed the measurements at the East Balt facility.

[*96] Next, we look to the shrinking-back rule. At trial, Mr. Betz identified an issue that occurred during the fabrication process, where CPI needed to increase the height of the exhaust stack in response to concerns from the EPA. To account for the increased size, CPI added a platform around the exhaust stack to the design in order to stabilize the stack during high wind periods. However, once again, petitioners failed to establish what information was unavailable with respect to the structural support and wind speed and (2) what activities particular CPI employees undertook to gather that information. To the contrary, Mr. Betz testified that CPI had already accounted for a potential high wind speed of 90 miles per hour when determining structural support for an oxidizer in the Chicago area; it is unclear what other information CPI needed to design the exhaust stack platform.

Petitioners did not credibly establish (1) that information was unavailable and (2) that particular CPI employees undertook investigative activities with respect to any other shrunk-back components of the oxidizer. We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the East Balt project.

p. *M&W Ireland (#14-07718)*

This project involved CPI's supply of a wastewater treatment system to an Intel Corp. facility in Ireland. The proposal accepted by M&W (Intel's general contractor) stated that CPI would "copy exactly" a previous wastewater treatment system supplied by CPI to Intel. The proposal further included several minor, site-specific design changes, some of which were necessitated by the need for the system components to meet European product standards (known as CE). CPI thus modified the design to include components from European suppliers. Petitioners suggest that these site-specific requirements required CPI to engage in an iterative process to determine a design that included components that were in compliance with European standards. At trial Mr. Harmsen testified that, on account of the European standards, CPI "had to go out and figure out and find parts and pieces that were CE approved" and then redesign the system to fit those approved components. An objective lack of information as to how to meet the European product standards could theoretically constitute an uncertainty within the meaning of the section 174 regulations. However, petitioners have not established (1) that information about the European product standards was unavailable to CPI or (2) that CPI employees conducted any relevant investigative activities. We find that

[*97] the information previously available to CPI (i.e., the information from its previous project with Intel) established the basic design specification of the project. *See Little Sandy Coal Co. v. Commissioner*, 62 F.4th at 299 ("[A] manufacturer may not simply 'add a few new bells and whistles' on a pre-existing product and claim uncertainty as to the whole.").

In addition, at the shrunk-back component level, petitioners have not established that CPI employees performed any investigative activities. We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the M&W Ireland project.[44]

q. *Enterprise (#14-07851)*

This project involved CPI's design and supply of two hot air recirculation systems and two internally insulated VOC hot gas bypasses. The record firmly establishes that, as of 2014, CPI had information available to it establishing the basic design specification of both products, each of which was a commonly used component in CPI's systems. Before 2014 CPI was particularly experienced in resolving the outdoor low temperature issues that Enterprise was facing, to the extent that CPI personnel had published an industry-facing article discussing its standard hot air recirculation solution. *Cf. Union Carbide Corp.*, 97 T.C.M. (CCH) at 1261 (concluding that information was available to taxpayer under section 174 in part because of taxpayer's experience in using particular component to solve design issue). CPI's generalized experience with the low temperature issue was bolstered by the site-specific information that Messrs. Betz and Harmsen obtained from their inspection of the Rifle facility's existing oxidizers in 2013. From that inspection, CPI determined that the oxidizer was experiencing issues

[44] In the alternative we also conclude that the expenditures incurred in connection with the M&W Ireland project are independently excluded from the definition of qualified research by way of the section 41(d)(4)(B) adaptation exclusion. *Cf. Trinity Indus., Inc.*, 691 F. Supp. at 697 & n.11 (holding in the alternative that adaptation exclusion applied to taxpayer's "refinement of a preliminary design" provided by customer). Whatever the scope of the adaptation exclusion, we find it evident that an exact copy of a previous product with some minor site-specific modifications falls squarely within its plain meaning. *See* § 41(d)(4)(B) (excluding "[a]ny research related to the adaptation of an existing business component to a particular customer's requirement or need"); *Adaptation*, *Oxford English Dictionary* (3d ed. 2011), https://www.oed.com/view/Entry/2115 (last updated March 2023) (defining adaptation as "[t]he action or process of adapting one thing to . . . suit specified conditions, esp. a new or changed environment, etc.").

[*98] with (1) recirculation of cold air at the inlet; (2) pinhole leaks; (3) uninsulated components; and (4) a possibly dangerous natural gas injector. On January 2, 2014, Mr. Harmsen submitted a report to Enterprise, detailing the inspection findings and the recommendation that Enterprise engage CPI to design and supply CPI's hot air recirculation solution and make other necessary fixes. That report included the necessary basic information and specifications for designing the components, including the particular VOCs at issue and the cold temperatures at the facility. We thus conclude that CPI had resolved any objective uncertainty about the basic design specification of the two components before 2014. *Cf. Siemer Milling Co.*, T.C. Memo. 2019-37, at *33 (concluding that project failed section 174 test where taxpayer already had prior-year testing information resolving uncertainty).

At trial, petitioners' counsel and Mr. Harmsen sought to characterize the ultimate design of the components as "significantly different" from the initial design projections in the report. This characterization appeared to rely on the fact that the final general arrangement drawing changed the location of the hot air recirculation duct system and added a new fan to one of the existing oxidizers. However, petitioners failed to further explain how the design of the hot air recirculation component itself (as opposed to its location) changed. Nor did petitioners produce evidence showing what activities particular CPI employees performed to gather information about the appropriate placement of the air recirculation duct system or the addition of the fan. We find Mr. Harmsen to lack credibility with respect to his testimony suggesting that the final design as a whole was "significantly different" from his initial recommendations.

We conclude that petitioners have not produced credible evidence establishing (1) what information was otherwise unavailable to CPI with respect to the design of the two components; and (2) what investigative activities CPI personnel undertook to obtain such information in 2014. To the extent that investigative activities were performed with respect to the Enterprise project, we find that they correspond to wages that were incurred in tax year 2013. We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the Enterprise project.

[*99] r. *DuPont La Porte (#14-07831)*

This project involved CPI's design and supply of a 1,067 SCFM direct thermal oxidizer for a chemical manufacturing facility. Petitioners identified the large size of the exhaust stack as a design uncertainty. However, petitioners failed to establish that CPI itself conducted any investigative activities intended to resolve this uncertainty. Indeed, we find that, in contrast to its typical process, CPI simply engaged IVI North to design the exhaust stack itself to DuPont's provided specifications, because CPI lacked the capability to do so.[45] Petitioners have offered no evidence establishing what (if any) investigative activities IVI North or CPI may have conducted with respect to the stack's design. *Cf. Union Carbide Corp.*, 97 T.C.M. (CCH) at 1261 (holding that uncertainty did not exist where third party designed product and taxpayer provided no evidence that it modified the design). Even if petitioners had been able to make such a showing with respect to IVI North, they have not contended at any point in this litigation that they incurred contract research expenses with respect to amounts paid to their subcontractors, and we would thus deem that issue conceded.[46] *See Petzoldt*, 92 T.C. at 683.

At trial Mr. Harmsen also identified the design of a custom burner for the project as a design difficulty. However, Mr. Harmsen testified that this entailed "going out and finding a supplier that could design a custom-made burner for this application." Even assuming arguendo that contacting suppliers for bids constitutes research and development within the meaning of the section 174 regulations, it is assuredly not part of a process of experimentation. *See Siemer Milling Co.*, T.C. Memo. 2019-37, at *36.

We conclude that petitioners have failed to carry their burden of establishing that CPI employees performed qualified services with respect to the DuPont La Porte project.

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[45] On this point, we find Mr. Harmsen's trial testimony—that IVI North did not do any design work—to lack credibility, in part because it directly conflicted with Mr. Betz's testimony, as well as with the IVI North quote and the purchase order CPI issued to IVI North, which described the agreed-upon services as "[d]esign and fabricate exhaust stack."

[46] As noted above, section 41(b)(3)(A) allows a limited amount of the credit for contract research expenses, defined as amounts paid or incurred "by the taxpayer to any person (other than an employee of the taxpayer) for qualified research."

[*100] s. *Reclaimed Energy (#14-07981)*

This project involved CPI's design and supply of a 15,000 SCFM regenerative thermal oxidizer. Because of CPI's longtime customer relationship with Reclaimed Energy, CPI personnel already had significant information about the facility's airflow from work on previous projects, much of which they re-incorporated into a P&ID drawing for the new oxidizer. Trial testimony by Mr. Harmsen further addressed the basis of this design:

> Petitioners' counsel: "What information were you provided at the beginning of the project?"
>
> Mr. Harmsen: "We had history with Ron [Snyder, a Reclaimed Energy representative] in his process, so we knew a little bit about it. What we wanted from him and what we received were what he could perceive as a maximum. So if he was adding a new distillation column, what was that going to do to his existing, how many rows are you going to add, and what would they produce. And we use that to try to reconcile against what the oxidizer maximums would be."

We understand Mr. Harmsen's testimony as stating that Reclaimed Energy provided CPI with information about the potential airflow volume and VOC concentrations at the Connersville facility, taking into account potential future expansion of the facility. Mr. Harmsen further testified that he input the VOC solvent toluene into a Bessy spreadsheet, because that was "the solvent [Ron] likes to say he has a lot of."[47] Using the provided information and the output of the spreadsheet, Mr. Harmsen and other CPI personnel were able to determine the appropriate size of the various components and reduce them to design drawings. Petitioners point to no evidence suggesting that CPI employees conducted investigative activities with respect to the basic design specification of the oxidizer. We thus find that the information provided to CPI by Reclaimed Energy established the appropriate design of the oxidizer as a whole, and CPI personnel thus did not perform activities intended to discover such information within the meaning of the section 174 regulations.

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[47] Mr. Harmsen also input methane into a separate Bessy spreadsheet to account for a possible worst-case scenario, because of methane's high BTU rating.

[*101] In addition, Mr. Harmsen's trial testimony did not establish that further investigative activities were performed with respect to any shrunk-back component of the oxidizer. We conclude that petitioners have failed to carry their burden of establishing that they satisfied the section 174 test with respect to the claimed wage QREs on the Reclaimed Energy project.

t. *Conclusion*

We conclude that petitioners have failed to carry their burden of establishing that the activities corresponding to their claimed wage QREs constituted qualified research or direct supervision or support of qualified research, within the meaning of section 41(b)(2)(B). Accordingly, we will sustain respondent's determination that petitioners are not entitled to a research credit.

D. *Funded Research Exclusion*

We now address the parties' arguments with respect to the funded research exclusion, as a discrete alternative holding. Section 41(d)(4)(H) excludes from the definition of qualified research "[a]ny research to the extent funded by any grant, contract, or otherwise by another person." Section 41 does not define the term "funded." The regulations provide two factors that are relevant in determining whether research is funded.[48] First, "[a]mounts payable under any agreement that are contingent on the success of the research and thus considered to be paid for the product or result of the research" are not treated as funding. *See* Treas. Reg. § 1.41-4A(d)(1); *see also Fairchild Indus., Inc. v. United States*, 71 F.3d 868, 870 (Fed. Cir. 1995) (describing exclusion as allocating the credit "to the person that bears the financial risk of failure of the research"). Second, "[i]f a taxpayer performing research for another person retains substantial rights in the research under the agreement providing for the research," that research is likewise not treated as funded. *See* Treas. Reg. § 1.41-4A(d)(3); *see also* Treas. Reg. § 1.41-2(a)(3). Respondent challenges petitioners' claim that CPI retained substantial rights in its research under the contracts for eight of the projects at issue.

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[48] Treasury Regulation § 1.41-4A is captioned "Qualified research for taxable years beginning before January 1, 1986" but remains applicable in relevant part for tax year 2014, by way of a separate regulatory provision. *See* Treas. Reg. § 1.41-4(c)(9) ("To determine the extent to which research is so funded, § 1.41-4A(d) applies."); *see also Tangel v. Commissioner*, T.C. Memo. 2021-1, at *9 n.4.

[*102] We determine whether a taxpayer has substantial rights in research by looking to the terms of the parties' contract for each project at issue. *See Tangel*, T.C. Memo. 2021-1, at *11; Treas. Reg. § 1.41-4A(d)(1); *see also Lockheed Martin Corp. v. United States*, 210 F.3d 1366, 1376 (Fed. Cir. 2000) (stating that application of the exclusion "must be determined by reference to the research agreements"). A taxpayer retains no substantial rights in research performed "under an agreement that confers on another person the exclusive right to exploit the results of the research." Treas. Reg. § 1.41-4A(d)(2). Similarly, a taxpayer retains no substantial rights in research "if the taxpayer must pay for the right to use the results of the research." *Id.* subpara. (3)(i); *cf. Lockheed Martin Corp.*, 210 F.3d at 1375 ("The right to use the research results, even without the exclusive right, is a substantial right."). Finally, "[i]ncidental benefits" to the taxpayer from performing research, such as "increased experience in a field of research," are not substantial rights. Treas. Reg. § 1.41-4A(d)(2). As with other elements of the research credit, petitioners bear the burden of showing that CPI retained substantial rights in the results of any research performed under the contracts. *See Dynetics, Inc. & Subs. v. United States*, 121 Fed. Cl. 492, 523 (2015).

We start by looking to the relevant caselaw and its treatment of contractual provisions similar to those at issue here. In *Tangel*, T.C. Memo. 2021-1, at *4-5, we reviewed a contract that stated in relevant part:

> A. With respect to Articles for which any technical information, written, oral or otherwise, (i) has been supplied to Seller by or on behalf of Buyer; or (ii) Seller has designed at Buyer's expense; or (iii) Seller has designed specifically to meet Buyer-furnished technical requirements (hereinafter designated "Information"), Seller, in consideration of Buyer's furnishing of such Information and/or design funding, agrees that it will not use, or assist others in using, such Information, design funding or tooling to develop or sell such Articles (or similar interchangeable or substitute Articles, or parts thereof) to anyone other than Buyer, either as production, spare or repaired Articles, without Buyer's prior written consent. Seller shall not use or disclose such Information except in the performance of Orders for Buyer, and, upon Buyer's request, such Information and all copies thereof shall be returned to Buyer.

[*103] B. Information prepared by Seller specifically in connection with performance of this Order, including original works of authorship created by Seller, are considered "works made for hire" within the meaning of the U.S. Copyright Laws. Buyer shall be deemed the author of such works. If any such work is determined by a court of competent jurisdiction not to be a work made for hire, this Order shall operate as an irrevocable assignment to Buyer of all right, title and interest in and to such work.

We concluded that paragraph A prevented the taxpayers from using the results of the research under the contract for any other purpose, unless the customer gave prior written consent. *Id.* at *12–13. We further concluded that paragraph B vested the customer with the right to any copyrightable materials created in performing the contract. *Id.* at *13–14. The taxpayers argued in part that the institutional knowledge gained from research was a substantial right; we squarely rejected this contention, characterizing institutional knowledge as a mere incidental benefit from performing research within the meaning of Treasury Regulation § 1.41-4A(d)(2). *Tangel*, T.C. Memo. 2021-1, at *16. Accordingly, we concluded that the taxpayers had failed to retain substantial rights in research under the contract.

In *Dynetics, Inc.*, 121 Fed. Cl. at 518–23, the Court of Federal Claims (CFC) analyzed two separate contracts under the substantial rights doctrine. The first contract, between the taxpayer and the University of Alabama, Huntsville (University), stated in relevant part:

> All rights, title, and interest in and to inventions or other intellectual property rights conceived or reduced to practice in the course of performance of the work called for by this Contract are hereby vested in the University. The contractor agrees to promptly disclose to the University, in a format acceptable to the University, any potentially patentable idea or concept conceived or reduced to practice in the course of performance of the work called for by this Contract.

Id. at 518.

The taxpayer argued that its work under the contract, which involved solving equations and developing simulations, was not patentable and was thus outside the scope of the terms. *Id.* Focusing

[*104] on the phrase "other intellectual property rights," the CFC determined otherwise and found that the contract vested a "broad category of rights" in the University, including both patentable and nonpatentable technology "conceived or reduced to practice in the course of performance." *Id.* at 519. Accordingly, the CFC concluded that the taxpayer had failed to retain substantial rights in the research with respect to the contract. *Id.*

The second contract, between the taxpayer and the United States Department of Defense (DOD), was subject to a number of standard national security requirements with respect to the taxpayer's use of classified intelligence information. *Id.* at 519–20. Those requirements prohibited the taxpayer from reproducing intelligence materials or releasing intelligence materials to others without authorization and required the return or destruction of all materials generated by the taxpayer as directed upon completion of the contract. *Id.* at 521. The taxpayer made a three-pronged argument, asserting that (1) it retained the right to use generalized "skills and advancements" that it developed in performing the contract; (2) it could use the particular research results for other contracts following authorization from the relevant component of DOD; and (3) a regulation incorporated into the contract provided that it would retain the rights to any patentable invention or discovery conceived or reduced to practice in performing the contract. *Id.* at 521–23.

With respect to the taxpayer's initial argument, the CFC characterized any skill or advancement gained as an "incidental benefit" from performing research and thus not a substantial right under Treasury Regulation § 1.41-4A(d)(2). *Dynetics, Inc.*, 121 Fed. Cl. at 521. With respect to the second argument, the CFC observed that the taxpayer had not answered "the obvious question of how it could have substantial rights in the results of the research, if it needed the government's 'authorization' to use those results." *Id.* Finally, while the CFC acknowledged that the taxpayer would retain patent rights under the contract, the CFC concluded that such a right would be irrelevant to whether the taxpayer retained substantial rights in the nonpatentable results of its research at issue. *Id.* at 523. The CFC thus concluded that the taxpayer retained no substantial rights in the research performed under this contract. *Id.*

Here, respondent points to the fact that CPI's standard terms and conditions are silent with respect to CPI's rights in its research. Respondent thus argues that the terms and conditions in the purchase

[*105] orders issued by CPI's customers control whether CPI retained substantial rights in research performed. Respondent identifies eight projects—3M Hutchinson, 3M Monrovia, 3M Hartford, Celanese, Smalley, Enterprise, Teva, and HAI—where the governing terms purportedly conferred on the customer all substantial rights in research.[49] Relying on *Lockheed Martin Corp.*, 210 F.3d at 1374, petitioners respond that the express transfer of usage rights in these contracts was not exclusive and thus CPI still retained substantial rights in the research. We now turn to the eight projects at issue.

1. *3M (#13-05720, 13-07611, 14-07784)*

The master agreement between CPI and 3M governed all three 3M projects for which CPI claimed the research credit for 2014. Clause 10.2 of the master agreement provided in relevant part that 3M owned all intellectual and tangible property rights in "any goods, equipment . . ., apparatus, documents, drawings, computer software and artwork which . . . [CPI] creates at 3M's expense or [CPI] creates using 3M Confidential Information ('3M Rights')." Clause 10.2 further provided that CPI assigned to 3M "all of [CPI's] rights, including, without limitation, all intellectual and tangible property rights" with respect to "any property subject to 3M Rights." Finally, clause 8.3 provided that "if [CPI] retains ownership" of any "drawing, illustrations, instructions, maintenance information, and other materials that relate to the Equipment," CPI "grants 3M the perpetual, unrestricted right to use, copy, and distribute those materials for 3M's internal use."

We find the contract terms to be unambiguous. Via clause 10.2, CPI assigned to 3M "without limitation, all intellectual and tangible property rights" in the work product resulting from research performed under the contract. In turn, clause 8.3 vested nonexclusive usage rights in 3M for materials that "relate to the Equipment," but only "if [CPI] retains ownership" of those materials. Reading the two clauses together, we understand clause 8.3 as inapplicable to work product that CPI did not retain ownership over, pursuant to the assignment in clause 10.2 (i.e., work product "create[d] at 3M's expense" or "create[d] using 3M Confidential Information"). Clause 8.3 thus appears to be a fallback provision, applying primarily to pre-existing, project-related materials

[49] We thus deem respondent to have conceded that, under the remaining 11 projects' contracts, CPI retained substantial rights and thus did not perform funded research. *See, e.g.*, *Petzoldt*, 92 T.C. at 683 (treating party's failure to argue point on brief as concession).

[*106] that (1) were not created in performing the project and (2) are owned by CPI.

We conclude that CPI no longer retained a right to use any of the work product and thus no longer retained a substantial right in the results of its research. *See* Treas. Reg. § 1.41-4A(d)(2); *see also United States v. Grigsby*, No. 19-00596, 2022 WL 11269773, at *4, *14–15 (M.D. La. Oct. 19, 2022) (finding no substantial rights where "all rights, title and interest" to similar work product was vested in customer). Absent a right to use such work product, CPI retained only incidental benefits from the project, namely any increased institutional knowledge. *See* Treas. Reg. § 1.41-4A(d)(2). Consequently, any research activities performed by CPI on the three 3M projects were funded research and thus excluded from the definition of qualified research.

2. *Celanese (#14-07852)*

The governing terms and conditions between CPI and Celanese provided that "any deliverables or other work product arising from" CPI's services would be confidential property of Celanese and thus could not be used by CPI "for any purpose other than as expressly contemplated by the Purchase Order." The terms also stated that CPI assigned to Celanese "all other copyright and derivatives, trade secret and other proprietary rights that arise out of the performance of the Services or that are applicable to any deliverables under the Purchase Order." Finally, the terms vested in Celanese the rights to all works eligible for copyright protection arising out of CPI's performance as "work[s] made for hire."[50] The terms provided that if "any such work is deemed for any reason not to be a work made for hire," CPI "hereby assigns all rights, title and interest in the copyright to such work" to Celanese.

Again, we find the contract terms to be unambiguous. We conclude that the applicable terms prohibited CPI from using the results of its research other than for the purpose of performing under the

[50] In copyright law, a work made for hire is "a work prepared by an employee within the scope of his or her employment" or "a work specially ordered or commissioned" within nine enumerated categories. 17 U.S.C. § 101; *see Cmty. for Creative Non-Violence v. Reid*, 490 U.S. 730, 750–52 (1989) (applying common law agency principles to determine whether person was employee within the meaning of copyright law); *Billy-Bob Teeth, Inc. v. Novelty, Inc.*, 329 F.3d 586, 591 (7th Cir. 2003). If the work was determined to be a work made for hire, the person "for whom the work was prepared is considered the author" for copyright purposes. 17 U.S.C. § 201(b).

[*107] contract. *See Tangel*, T.C. Memo. 2021-1, at *13 (finding no substantial rights in contract that prevented seller "from using the results of its research for any purpose outside" of performing under the contract). The terms also expressly vested in Celanese the rights to all copyrightable material arising out of CPI's work under the contract as either works made for hire or, in the alternative, as an outright assignment. *See id.* at *5, *16 (analyzing similar provision); *Grigsby*, 2022 WL 11269773, at *15 ("Together, the . . . [c]ontract's 'work for hire' and transfer of title provisions eliminate any plausible reading under which [the taxpayer] retains the right to use."). CPI conferred on its customer the exclusive right to use the results of its research and the intellectual property rights to any copyrightable material, reserving to itself only the institutional knowledge—an incidental benefit—that it gained in designing the oxidizer system. Consequently, any research activities performed by CPI on the Celanese project were funded research and thus excluded from the definition of qualified research.

3. *Smalley (#14-07658)*

Clause 6 of governing terms and conditions between CPI and Smalley provided that CPI would keep confidential "all information, drawings, specifications or data furnished by Buyer" and would "not divulge or use such information, drawings, specifications or data" except in performing its contractual obligations to Smalley. Clause 6 also provided that, upon completion of the order, CPI would "make no further use, either directly or indirectly, of any such data or of any information derived therefrom without obtaining Buyer's prior written consent."

We find these contract terms to be ambiguous with respect to whether CPI retained substantial rights. Clause 6 could be read as divesting CPI of a right to use "all information, drawings, [and] specifications," as well as all "data furnished by" Smalley. The ambiguity derives from the placement of the phrase "furnished by Buyer." One method of resolving that ambiguity would be to apply the last antecedent rule.[51] Under that rule, a limiting phrase (here, "furnished by Buyer") should presumptively be read as modifying only the noun that immediately precedes it (here, "data"). *Barnhart v. Thomas*, 540 U.S. 20, 26 (2003). However, the rule "is not an

[51] Neither CPI nor Smalley appears to have included a choice-of-law provision in the contract documents, and both CPI and Smalley are based in Illinois. Illinois courts apply the last antecedent rule in construing ambiguous contract terms. *See, e.g.*, *State Farm Mut. Auto. Ins. Co. v. Murphy*, 136 N.E.3d 595, 602–03 (Ill. App. Ct. 2019).

[*108] absolute and can assuredly be overcome by other indicia of meaning." *Id.*

We conclude that the last antecedent rule is inapposite here, for several contextual reasons. Clause 6 goes on to require that CPI "*return* such information, drawings, specifications and data" (emphasis added) to Smalley upon completion of the contract, thus suggesting that CPI was required only to give back materials furnished to it by Smalley, not deliver newly generated materials to Smalley. Further, the preceding clause 5 states in relevant part: "If drawings and specifications are furnished by Buyer, this Order shall be based upon such drawings and specifications." That prior context, which connects "drawings and specifications" with being "furnished by" Smalley, is relevant to reading "all information, drawings, specifications or data" in clause 6. *See Martindell v. Lake Shore Nat'l Bank*, 154 N.E.2d 683, 689 (Ill. 1958) ("The intention of the parties is not to be gathered from detached portions of a contract or from any clause or provision standing by itself, but each part of the instrument should be viewed in the light of the other parts."). Given that context and the simplicity of the categories "information, drawings, specifications or data," a reader can intuitively apply "furnished by" as a modifier to each category. *See Lockhart v. United States*, 577 U.S. 347, 352 (2016) (observing that the last antecedent rule is less applicable where "the listed items are simple and parallel without unexpected internal modifiers or structure"). To narrowly construe only one category as modified by the limiting phrase, despite the categories' similarities, is thus not the most natural reading of the provision. *See Paroline v. United States*, 572 U.S. 434, 447 (2014) ("When several words are followed by a clause which is applicable as much to the first and other words as to the last, the natural construction of the language demands that the clause be read as applicable to all." (quoting *Porto Rico Ry., Light & Power Co. v. Mor*, 253 U.S. 345, 348 (1920))); *see also Facebook, Inc. v. Duguid*, 141 S. Ct. 1163, 1169 (2021). We read the provision as prohibiting only CPI's use of work product "furnished by" Smalley to CPI. Consequently, we conclude that clause 6 does not necessarily preclude CPI from retaining substantial rights in the results of any research it performed itself under the Smalley contract.

We turn now to clause 10 of the terms, which defined "Buyer-Owned Property" as "any tools, tooling, patterns, equipment, materials, or other property used in the manufacture of the Goods . . . that are either supplied to [CPI] by [Smalley] or have been acquired by [CPI] and specifically paid for by [Smalley]." The terms stated that CPI "shall not

[*109] use Buyer-Owned Property in the performance of any other work without prior written approval of [Smalley]" and that "[t]itle to all Buyer-Owned Property shall at all times remain with [Smalley]." We find these terms to be unambiguous in vesting ownership in Smalley of certain property provided by Smalley to CPI or acquired and specifically paid for by Smalley and then used by CPI in performing the contract. However, clause 10 on its face does not apply to property that CPI developed itself (rather than acquired) in the course of performing the contract (i.e., the results of research). Reading clauses 5, 6, and 10 together, we conclude that CPI's retained right to use the work product results of research it performed was substantial. Accordingly, we hold that any research that CPI performed on the Smalley project was not excluded from the definition of qualified research.

4. *Enterprise (#14-07851)*

The governing terms and conditions between CPI and Enterprise provided that Enterprise would be the owner of "all information and materials resulting from [CPI's] services, including sketches, layouts, negatives, photographs, designs, blueprints, and specifications relating thereto, and of the work product of all services furnished or performed . . . including all creative ideas included therein." The terms also stated that "[n]o copies or reproductions" of the information and materials would "be made or retained by [CPI] except as authorized in writing by [Enterprise]."

We construe the terms as requiring CPI to seek permission from Enterprise to retain and use any information, materials, and work product generated in performing the contract. *Cf. Dynetics, Inc.*, 121 Fed. Cl. at 521 (construing similarly provisions for taxpayer to seek permission from customer for use or reproduction of material). No provision otherwise limited Enterprise's ability to withhold consent from CPI as to the retention of such materials. *See Tangel*, T.C. Memo. 2021-1, at *17 ("Having to secure permission to use the research, with no conditions limiting the other party's ability to withhold consent, prevents [the taxpayer] from possessing substantial rights."). If CPI was unable to retain and use such information, material, and work product without permission, then we fail to see what rights CPI retained under the contract to any research performed, aside from the incidental benefit of increased knowledge and experience. *See* Treas. Reg. § 1.41-4A(d)(2); *see also Dynetics, Inc.*, 121 Fed. Cl. at 521 ("[The taxpayer] does not address the obvious question of how it could have substantial rights in the results of the research, if it needed the [customer's] 'authorization'

[*110] to use those results."). We thus conclude that any research that CPI performed on the Enterprise project was funded and thus excluded from the definition of qualified research.

5. *Teva (#14-07808)*

The governing terms and conditions between CPI and Teva provided that CPI would "not use, sell, loan or publicize any of the tools, specifications, blueprints, designs or artwork supplied or paid for by Buyer for the fulfillment of this order without Buyer's written consent." We conclude that this provision presents the same issue as clause 10 of the Smalley terms discussed above. While the terms divested CPI of the unconditional right to use certain "tools, specifications, blueprints, designs or artwork," the scope is limited to such materials as are "supplied or paid for by [Teva] for the fulfillment of this order." Accordingly, CPI retained the unconditional right to use work product results that it itself generated in performing any research on the project. We thus conclude that any research that CPI performed on the Teva project was not funded and thus is not excluded from the definition of qualified research.

6. *HA International (#13-07615)*

The governing terms and conditions between CPI and HAI provided that HAI would be "entitled to all documents, drawings, specifications, calculations and other information carriers" with respect to CPI's activities for HAI. The terms went on to state that HAI would be "solely entitled to all intellectual property rights (including patents) created during the performance of the obligations" under the contract. Finally, the terms provided that HAI would have a "full license to use" any intellectual property, in a case where "the intellectual property rights are with both" CPI and HAI.

We find the HAI terms to be unambiguous as to CPI's rights in the research. In interpreting the contract between CPI and HAI, we apply Ohio law, pursuant to the choice-of-law provision in the HAI terms. This includes the familiar maxim that we must construe a contract "so as to give effect to all of its provisions." *R.L.R. Invs., LLC v. Wilmington Horsemens Grp., LLC*, 22 N.E.3d 233, 240 (Ohio Ct. App. 2014). In doing so, we "presume that the intent of the parties is reflected in the plain language of the contract" and thus "enforce the terms as written." *Beverage Holdings, LLC v. 5701 Lombardo, LLC*, 150 N.E.3d 28, 31 (Ohio 2019); *see also Stewart v. Hartford Life & Accident Ins. Co.*,

[*111] 43 F.4th 1251, 1255 (11th Cir. 2022) ("When interpreting a written text—a contract no less than a statute—we generally understand 'a material variation in terms [to] suggest[ ] a variation in meaning.'" (quoting Antonin Scalia and Bryan A. Garner, *Reading Law: The Interpretation of Legal Texts* 51, 170 (2012))).

The text of the provision at issue is clear as to what rights in research were vested in HAI. While HAI was "solely entitled" to intellectual property rights created during the contract, HAI was "entitled" only to the various work products used by CPI in performing the contract. Giving effect to both clauses and their material difference (i.e., the presence or absence of "solely"), we construe the terms as providing HAI with only a nonexclusive right to use the work product, as contrasted with its exclusive right to intellectual property. CPI thus necessarily retained its own right to use any work product generated under the contract. This right to use was substantial. *See Lockheed Martin Corp.*, 210 F.3d at 1378 (concluding that the "right to use is not a zero-sum game" and that the taxpayer still retained substantial rights in research despite its customer's "unlimited right to use, duplicate, and disclose" research). We thus conclude that any research that CPI performed on the HAI project was not excluded from the definition of qualified research as funded.

7. *Conclusion*

For five of the eight projects at issue—3M Hutchinson, 3M Hartford, 3M Monrovia, Celanese, and Enterprise—we conclude that any research performed by CPI was funded and thus independently excluded from the definition of qualified research. As an alternative holding, we will thus partially sustain respondent's determination to disallow CPI's claimed research credit on this basis with respect to these projects.

E. *Accuracy-Related Penalties*

Section 6662(a) and (b)(1) and (2) imposes a 20% accuracy-related penalty on, as relevant here, any underpayment of federal income tax which is attributable to negligence, disregard of rules or regulations, or a substantial understatement of income tax. Negligence includes "any failure to make a reasonable attempt to comply" with the Code, *see* § 6662(c), or a failure "to keep adequate books and records or to substantiate items properly," *see* Treas. Reg. § 1.6662-3(b)(1). An understatement of income tax is "substantial" if it exceeds the greater

[*112] of 10% of the tax required to be shown on the return or $5,000. § 6662(d)(1)(A).

Respondent argues that petitioners are liable for a penalty under section 6662(a) on the basis of both negligence and a substantial understatement of income tax. Generally, the Commissioner bears the initial burden of production to establish via sufficient evidence that a taxpayer is liable for penalties and additions to tax; once this burden is met, the taxpayer must carry the burden of proof, including with regard to defenses such as reasonable cause. § 7491(c); *see Higbee v. Commissioner*, 116 T.C. 438, 446–47 (2001). As part of that burden, the Commissioner must satisfy section 6751(b), by producing evidence of written approval of the penalty by an immediate supervisor, made before formal communication of the penalty to the taxpayer. *See Graev v. Commissioner*, 149 T.C. 485, 493 (2017), *supplementing and overruling in part* 147 T.C. 460 (2016); *see also Clay v. Commissioner*, 152 T.C. 223, 246 (2019), *aff'd*, 990 F.3d 1296 (11th Cir. 2021).

Petitioners have conceded that respondent secured timely written supervisory approval for the accuracy-related penalties pursuant to section 6751(b)(1), thus satisfying part of respondent's initial burden. *See, e.g.*, *Sestak v. Commissioner*, T.C. Memo. 2022-41, at *8 (accepting stipulation that agent obtained approval from immediate supervisor before formal communication as satisfying section 6751(b)(1)). We also conclude that respondent carried his burden of establishing that petitioners were negligent with respect to their underpayments of tax, failing to maintain adequate records substantiating their entitlement to the research credits. *See* Treas. Reg. § 1.41-4(d) ("A taxpayer claiming a credit under section 41 must retain records in sufficiently usable form and detail to substantiate that the expenditures claimed are eligible for the credit."); *see also* § 6001; Treas. Reg. § 1.6001-1(a). Alternatively, petitioners are liable for section 6662 penalties on the basis of substantial understatements of income tax to the extent that the understatements meet the applicable definition. *See* § 6662(d)(1)(A).

Section 6664(c)(1) provides that a section 6662 penalty will not be imposed for any portion of an underpayment if the taxpayer shows reasonable cause and good faith with respect to that underpayment. A taxpayer may establish reasonable cause by showing actual, good-faith reliance on the advice of a competent tax professional. *See Neonatology Assocs., P.A. v. Commissioner*, 115 T.C. 43, 99 (2000), *aff'd*, 299 F.3d 221 (3d Cir. 2002); Treas. Reg. § 1.6664-4(b)(1), (c)(1). In posttrial briefing, petitioners made the single statement, as a proposed finding of fact, that

[*113] they "are not liable for penalties under section 6662(a)," with a supporting citation of the "Entire Record." Petitioners made no other statement or argument in their posttrial briefing with respect to their liability for accuracy-related penalties; nor did petitioners argue on brief that they had reasonable cause and acted in good faith with respect to any underpayment.[52] *See* Rule 151(e)(5) (requiring that parties' arguments in posttrial briefing "set[] forth and discuss[] the points of law involved and any disputed questions of fact"); *cf. United States v. Dunkel*, 927 F.2d 955, 956 (7th Cir. 1991) ("A skeletal 'argument', really nothing more than an assertion, does not preserve a claim."). As noted above, reasonable cause is an affirmative defense, for which the taxpayer bears the burden of proof. *See ATL & Sons Holdings, Inc. v. Commissioner*, 152 T.C. 138, 154 (2019). Petitioners' failure to raise reasonable cause in posttrial briefing thus constitutes an abandonment of the issue. *See Mendes*, 121 T.C. at 312–13; *Efron v. Commissioner*, T.C. Memo. 2012-338, at *23 (concluding that taxpayer conceded reasonable cause when he failed to argue it on brief); *see also Sanchez v. Miller*, 792 F.2d 694, 703 (7th Cir. 1986) ("It is not the obligation of this court to research and construct the legal arguments open to parties, especially when they are represented by counsel."). We will to the extent stated herein sustain respondent's determination that petitioners are liable for accuracy-related penalties for tax years 2014, 2015, and 2016.[53]

III. *Conclusion*

For the foregoing reasons, we hold (1) that petitioners are not entitled to a section 41 research credit and (2) that petitioners are liable for section 6662(a) penalties. We have considered all of the arguments made by the parties and, to the extent they are not addressed herein, we find them to be moot, irrelevant, or without merit.

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[52] Indeed, before posttrial briefing petitioners expressly conceded in a stipulation of settled issues that they did not rely upon Mr. Smiejek of Porte Brown nor any other representative of Porte Brown in claiming the research credit on CPI's 2014 Form 1120S.

[53] Alternatively, even if reasonable cause had been properly raised, we would still conclude that any apparent reliance by petitioners on Alliantgroup with respect to claiming the research credits was inconsistent with ordinary business care and prudence and thus that petitioners failed to establish reasonable cause for their underpayments of tax. *See* § 6664(c).

[*114] To reflect the foregoing,

Appropriate decisions will be entered.