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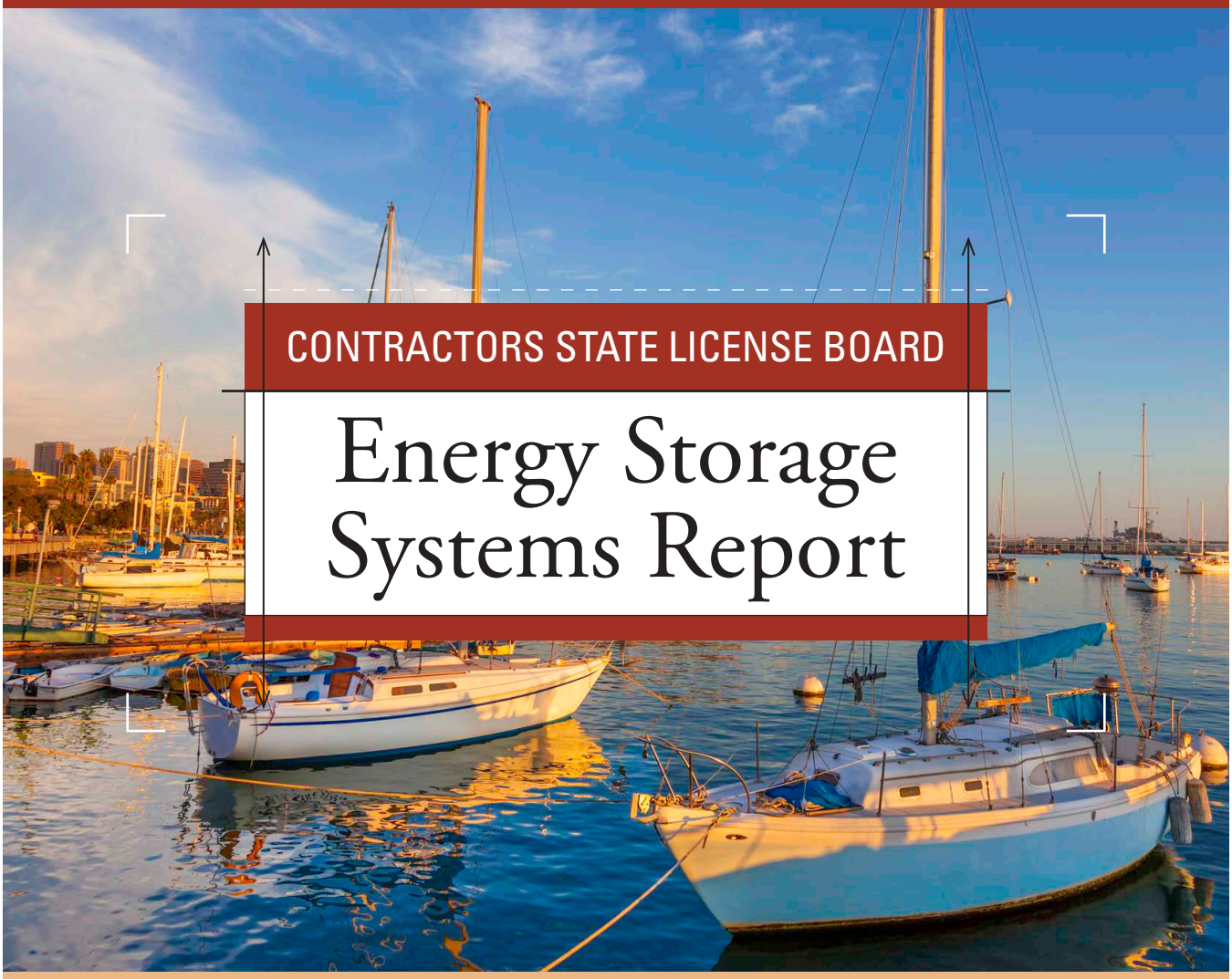

CONTRACTORS STATE LICENSE BOARD

Energy Storage Systems Report

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March 2019
Staff Report to the Board

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SECTION ONE:

Energy Storage Systems Issue at CSLB: Timeline of Relevant Events

The following timeline details the chronological events in recent history that led to the development of this energy storage systems (ESS) report.

July 5, 2005: Then-Registrar of the Contractors State License Board (CSLB) Stephen Sands issued a letter to the International Brotherhood of Electrical Workers that states that, for the purposes of photovoltaic systems on residential and commercial buildings and projects that "feed into the utility grid or otherwise offset the energy costs for structures they serve," the C-10 Electrical or C-46 Solar contractor licenses are the appropriate classifications. (**EXHIBIT 1**) The letter further states that the A-General Engineering Contractor and B General Building Contractor may contract for the installation of those systems within the scope of their existing classification.

August 27, 2009: With the increased popularity in alternative energy projects, CSLB issued a "Fast Facts on Solar Projects" bulletin for "contractors seeking to venture into these emerging technologies."[1] The licenses identified in the bulletin as qualified to "perform solar projects" are A-General Engineering, B-General Building, C-4 Boiler, Hot-Water Heating and Steam Fitting, C-10 Electrical, C-20 Warm-Air Heating, Ventilating and Air Conditioning, C-36 Plumbing, C-46 Solar, C-53 Swimming Pool, and C-61/D-35 Swimming Pool and Spa Maintenance. The bulletin emphasizes that the solar projects each classification is authorized to perform is limited to (must be performed within) the existing scope of the license.

December 30, 2009: The CSLB formally amends the C-46 Solar Contractor license classification (Title 16, Division 8, Article 3, § 832.46 of the California Code of Regulations). Prior to December 2009, the C-46 classification read:

> A solar contractor installs, modifies, maintains, and repairs active solar energy systems. An active solar energy system consists of components which are thermally isolated from the living space for collection of solar energy and transfer of thermal energy to provide electricity and/or heating and cooling of air or water. Active solar energy systems include, but are not limited to, forced air systems, forced circulation water systems, thermosiphon systems, integral collector/storage systems, radiant systems, evaporative cooling systems with collectors, regenerative

> rockbed cooling systems, photovoltaic cells, and solar assisted absorption cooling systems.
>
> A licensee classified in this section shall not undertake or perform building or construction trades, crafts or skills, except when required to install an active solar energy system.

After the amendment (and through present day), the classification now reads:

> A solar contractor installs, modifies, maintains, and repairs thermal and photovoltaic solar energy systems.
>
> A licensee classified in this section shall not undertake or perform building or construction trades, crafts, or skills, except when required to install a thermal or photovoltaic solar energy system.

June 30, 2010: The CSLB issued an updated version of the August 2009 fact sheet on the contractor license categories that are authorized to perform work on "solar energy projects."[2] The C-46 description is modified to reflect the 2009 regulatory change to that classification. The bulletin again explains that the solar projects each classification is authorized to perform is limited to (must be performed within) the existing scope of the license. The latest Description of Classifications published by CSLB (2016) includes the same list as the updated June 2010 fact sheet.[3]

October 28, 2016: The CSLB Enforcement Committee included as an agenda update a "Review of Solar Energy Storage System CSLB Classifications"[4] in its committee packet. The update states that a C-46 Solar Contractor cannot install energy storage systems and that the most appropriate classification for doing so is the C-10 Electrical Contractor.[5] At the meeting, Board member Frank Schetter made a motion to add energy storage systems (ESS) to the C-10 Electrical Contractor regulation. Counsel and staff clarified that the agenda update in this packet was staff's effort to clarify which classifications are appropriate to install ESS, and that the update is not a regulatory change and does not request a regulatory change. Counsel clarified that if there is a request to clarify which classifications could install ESS in regulation, that the Board would have to place the request on next Board meeting agenda.

November 15, 2016: Then-Registrar Cindi Christenson issued a letter in response to an inquiry from an industry representative regarding the proper classification to install energy storage systems (**EXHIBIT 2**). The letter states that a C-10 Electrical Contractor is the appropriate classification to install energy storage systems in existing structures, and that an A-General Engineering classification is appropriate if the work includes "a plant or facility to house the system." Staff who assisted in preparing the letter confirmed that the letter intentionally does not mention photovoltaics or the installation of energy storage in connection with a solar system and applies to the installation of standalone systems.

December 8, 2016: During the public comment portion of the December 8, 2016 Board Meeting, Board member Frank Schetter requested that an item on "solar classification and energy storage systems" be placed on the next Licensing Committee meeting agenda.[6]

February 10, 2017: A "Discussion Regarding CSLB License Classifications and Regulations that Authorize Contractors to Install Energy Storage Systems" is placed on the February 10, 2017 Licensing Committee Meeting Agenda. At the meeting, it was determined that the matter would not be addressed at that time and would be "tabled."[7]

March 13, 2017: The energy storage systems agenda item from the February 2017 Licensing Program update is made an item for discussion at the March 13, 2017 Board meeting. It was again determined that the matter would not be addressed at that time.[8]

July 18, 2017: Then-CSLB Classification Deputy issued a letter in response to an inquiry from an industry representative regarding the proper classification to "install energy storage systems as part of a solar system installation." (**EXHIBIT 3**) The letter provides that "the C-46 – Solar classification may install energy storage systems as part of a solar system installation," and that the "C-10 Electrical classification may install energy storage systems as part of a photovoltaic system installation as well as an independent project." This letter resulted in the inclusion of the C-46 Solar Contractor in the list of the California Public Utilities Commission's list of Self Generation Incentive

Program (SGIP)-eligible licenses "for the combined installation of solar photovoltaics and energy storage systems" in its December 2017 edition of the SGIP handbook.[9]

February 23, 2018: A "Review, Discussion, and Possible Action on License Classifications Authorized to Install Energy Storage Systems" is placed on the agenda for the February 23, 2018 Licensing Committee meeting. Prior to the meeting, CSLB received several letters from the public about the appropriate classifications for the installation of energy storage systems. The letters were published into a packet to supplement the committee meeting materials.[10] The February 23, 2018 agenda update in the packet summarizes the letters and includes a staff recommendation for consideration by the Committee.[11] Public comment and board discussion on the topic ensued at the meeting.[12]

The Committee ultimately passed the staff recommendation in the packet, on a 6-1 vote, as follows:[13]

> To direct staff to conduct public meeting(s) to determine if the "A" (General Engineering), "B" (General Building), C-4 (Boiler, Hot-Water Heating and Steam Fitting), C-10 (Electrical), C-20 (Warm-Air heating, Ventilating and Air Conditioning), C-36 (Plumbing), C-46 (Solar), and C-53 (Swimming Pool) classifications should be precluded from installing an energy storage system in a standalone contract or when included in the installation of a solar system. After the public/work group meetings conclude, staff will report any findings to the full Board to determine if policy, regulatory, or statutory changes are needed.

These eight classifications were named in the staff recommendation because they each had been previously publicly identified by the Board as classifications "authorized to perform solar construction or installation."[14] **It is this motion from which this report is derived.**

April 13, 2018: A "Review, Discussion, and Possible Action on License Classifications Authorized to Install Energy Storage Systems" (ESS) is placed on the agenda for the April 13, 2018 Board meeting. The Board packet update includes the following statements:[15]

- A "C-10 (Electrical) classification is the most appropriate classification authorized to install a stand-alone electrical system."
- A "C-46 solar contractor can install an ESS, if the installation is in connection to a photovoltaic system."
- An "A" (General Engineering) contractor may install an ESS system as part of the installation of a solar system "if the installation requires specialized engineering."
- A "B" (General Building) contractor may install an ESS system as part of the installation of a solar system "if the installation is in connection to a structure."

The packet update includes a staff recommendation for the Board's consideration.[16] Public comment and board discussion on the topic ensued at the meeting.[17] The Board ultimately passed the staff recommendation in the packet, on a 13-0 vote, as follows: to "direct staff to hold a public meeting to collect information about energy storage systems."[18]

April 17, 2018: The CSLB announced its intent to hold a public participation hearing to gather information on energy storage systems that will be used to review the appropriate classification(s) to install an energy storage system in a standalone contract or as part of the installation of a solar photovoltaic system.[19] Both before and after this meeting, CSLB received numerous letters from the public arguing for or against C-10 or C-46 contractors installing energy storage systems. See **Section 5** of this report for summaries of all the letters received on this issue.

April 25-26, 2018: At its headquarters in Sacramento, the CSLB held the two-day public participation hearing on energy storage systems. See **Section 3** of this report for summaries of the testimony from both days.

August 8, 2018: Following a meeting with CSLB staff, representatives from the C-10 electrical contracting industry and the C-46 solar contracting industry agreed to create and submit, on behalf of their respective license classifications, an educational video demonstrating a residential and commercial energy storage system installation for CSLB staff review. The videos from each industry were received on February 9 and February 11, 2019, respectively.[20]

August 31, 2018: The CSLB distributed a survey to more than 300 building departments throughout the state. The survey asked questions about safety, code requirements and license classifications involved with the installation of solar photovoltaic systems. See **Section 4** of this report for summaries of survey responses from building departments.

December 13, 2018: During the Executive Division program update at the December 13, 2018 Board meeting, Registrar David Fogt notified the Board that staff intends to have an energy storage system report available for the Board's review by the March 2019 board meeting.[21]

January 17, 2019: CSLB staff hosted a meeting of C-10 Electrical Contractor industry experts to discuss the technical requirements and safety risks of the installation of energy storage systems.

January 18, 2019: CSLB staff hosted a meeting of C-46 Electrical Contractor industry experts to discuss the technical requirements and safety risks of the installation of energy storage systems.

January 30, 2019: CSLB staff hosted a meeting with a representative of the California Building Industry Association on the topic of energy storage systems and the California Energy Commission adoption of building standards to require solar photovoltaic systems on residential buildings starting in 2020.

SECTION TWO:

CSLB Regulatory Process and Solar License Regulatory History

CSLB Regulatory Rulemaking Process

When adopting regulations, the Board must follow the rulemaking procedures in the Administrative Procedure Act (APA). The APA requirements are designed to provide the public with a meaningful opportunity to participate in the adoption of regulations. The rulemaking process broadly includes development of documents and information on which the rulemaking action is based, sets related timeframes, provides opportunities for public participation and response to public comment, and defines the regulatory language, all of which is incorporated into a "rulemaking file." Regulatory rulemaking files require approval from the Department of Consumer Affairs, Business Consumer Services and Housing Agency, Department of Finance, and the Office of Administrative Law before final adoption by the Board. The time for development and approval of regulations is approximately 18-24 months.

Summary of the Regulatory History of the License Classifications the Board has Authorized to Perform Solar System Installations

For convenience of the reader, the next three paragraphs summarize the regulatory history that is detailed in pages 12 through 21 of this report. It should be noted that the formal regulatory documentation does not mention storage batteries of any kind, lead-acid or otherwise. However, solar thermal energy storage systems were among the first energy storage systems solar contractors were authorized to install in California.

Licensed contractors have been installing solar energy systems in California for nearly 40 years. In July 1979, CSLB began issuing its first solar license, the SC-44 solar license. As a supplemental classification (SC), the SC-44 was only issued to contractors already holding an A, B, C-4, C-20, C-36, C-53, or C-61 / D-35 license.[1] The SC-44 could contract for solar energy installations consistent with the scope of one of these

[1] A-General Engineering Contractor, B-General Contractor, C-4 Boiler, Hot-water Heating and Steam Fitting Contractors, C-53 Swimming Pool Contractors, C-20 Warm-Air Heating, Ventilating and Air Conditioning Contractor, C-36 Plumbing Contractor, C-53 Swimming Pool Contractor, C-61/D-35 Pool and Spa Maintenance Contractor.

primary classifications only. No certification of experience or examination was required, and SC-44s had to report to CSLB twice a year about the projects they were completing under the SC-44 license.

Most solar work at the time involved hot water system and swimming pool heating. The SC-44 was written to encompass the installation of solar thermal systems and not solar photovoltaic systems;[2] however, by June 1980, it became clear that the Board would need to consider advancement of photovoltaics (PV) in the industry. After two years of monitoring the work of SC-44 contractors, staff found that most were working beyond the scope of their primary classification by undertaking all phases of solar installations. By April 1981, after meeting with industry, utility companies, building officials, and solar training institutions, staff recommended to the Board the creation of a C-46 solar specialty license and elimination of the SC-44. The rationale provided was that a new specialty class, rather than a supplemental license, would allow the Board to verify the practical skills of applicants to the class, including "HVAC, electrical, plumbing, engineering, other associated trades." At a September 1981 Board meeting, the Board confirmed that it was the intent of the new C-46 classification to include the electrical components of solar systems. At the same meeting, it was clarified that A-General Engineering Contractors and B-General Contractors could install all forms of solar in connection with a structure or an engineering project, respectively.

In April 1982, the Board amended its regulations to add the words "solar heating" and/or "solar equipment" to the C-4, C-20, C-36, and C-53 classifications, to allow those classes to continue solar thermal work. To allow the C-10 Electrical Contractor and C-46 Solar Contractor to install PV systems, the amendments also added the words "solar photovoltaic cells" to the C-10 classification and created the new C-46 Classification to include the words "photovoltaic cells" and "electricity." The C-46 classification was not substantively amended again until 2009, when text that refers to "outdated types" of solar energy systems was deleted from the classification. The 2009 C-46 definition was

[2] Solar thermal involves the production of energy from sunlight using various mechanical devices other than photovoltaics for the purpose of heating liquid or spaces within facilities or buildings.

amended to refer to thermal and photovoltaic solar energy systems and "to allow for new innovations that would also meet this definition." The final statement of reasons for this amendment rejected a public comment that suggested that only certified electricians be allowed to connect PV panels to the inverter and building, on the grounds that such work is incidental and supplemental to the installation of a solar system.

Regulatory History of the License Classifications the Board has Authorized to Perform Solar System Installations

The following chronological events between 1978 and 2009 are summarized from the C-46 Solar Contractor regulatory file and do not include any editorializing, analysis, or commentary by the authors of this report. Any underlined text that is quoted or blocked in a paragraph in this section was underlined in the original excerpt.

October 20, 1978:[22] CSLB adopts for the first time a solar classification, in Sections 756.1 (Assignment of Supplemental Solar Classification), 756.2 (Qualification for Supplemental Solar Classification), 756.3 (Solar Project Reporting Requirements), and 754.16 (Class SC-44 Supplemental Solar Classification) of the California Code of Regulations, as follows:

> **754.16** A solar installation contractor is a contractor classified in one or more of the following areas: A, B, C-4, C-20, C-36, C-53, C-61 (pool maintenance contractor) who executes contracts or subcontracts requiring the ability and skill to competently and effectively install, maintain, repair, or modify an active solar system. An active solar system consists of components which are thermally isolated from the living space for collection of solar energy and transfer of thermal energy to provide heating, cooling, or heating and cooling. Active solar systems include, but are not limited to, forced air systems, forced circulation water systems, thermosiphon systems, integral collector/storage systems, radiant systems, evaporative cooling systems with collectors, regenerative rockbed cooling systems, solar-assisted absorption cooling systems and solar -assisted heat pump systems.
>
> **756.1** No person shall engage in the activities of a solar installation contractor as defined in Section 754.16 without at the time of so doing possessing a valid supplemental solar classification.
>
> **756.2** A supplemental solar classification may be obtained by: (a) Possessing a valid license in one or more of the following classifications: A, B, C-4, C-20, C-36, C-53, C-61 (pool maintenance contractor), and (b) Paying the fee established by Section 7137 of the Business and Professions Code.

The board voted to establish the supplemental classification for a number of reasons, noting the increasing potential of solar contracting work.[23] There was "a great impetus" [to adopt the classification] because of "available tax incentives for solar energy systems, pressures of rising energy costs, and pressures of new technology;" no one "was quite sure where the industry was going" but CSLB "knew it should involve us."[24] The focus was on "active systems" and intentionally "did not attempt to get into passive side of the issue."[25] There had also up to that point (1978) been a pattern of complaints relating to unlicensed activities, out of class complaints, design, workmanship, oversold systems, and misrepresentations made to owners.[26]

The SC-44 license was intentionally issued without requiring certifications of experience or an examination; SC-44 licensees would instead report to CSLB twice a year about the projects they were completing under the SC-44 license as issued.[27] At the time the classification was adopted, C-36 Contractors "account for a very large portion of the solar work that's been done," which included "hot water system and swimming pool heating."[28]

The 1978 regulatory hearings testimony on the adoption of the SC-44 license focused on concerns that "90% of the solar installations required plumbing or heating and air conditioning skills for final connection into existing conventional heating systems."[29] The board created the SC-44 "based on this testimony that the SC-44 would be dependent on certain existing primary classifications and skills" and the new classification would represent "an effort to monitor and assess development of the industry,"[30] which was a reference to the new (Section 756.3) requirement that the SC-44 licensees report to the board the solar installations they have completed twice per year. After receiving the reports from licensees, the board would then "close the monitoring period" and determine the final course of action."[31]

July 1, 1979: Board begins issuing the SC-44 supplemental solar classification only to entities holding an A, B, C-4, C-20, C-36, C-53, C-61 (swimming pool maintenance). A letter from Registrar John F. Maloney to local building officials clarifies that the "intent of issuing the SC-44 license is to monitor and regulate the solar energy installations in

California and not to expand the rights or practice of licensees beyond that which they are otherwise entitled to engage in by virtue of their primary classification."[32]

December 1, 1979: CSLB formally issues a publication (a chart) included with all SC-44 license correspondence and letters to the public, which clarifies what each of the prerequisite classifications could install, as follows:

> B-General "installation of all solar systems on buildings that support, shelter, and enclose people, animals, chattel, or moveable property of any kind, the construction of which requires the use of more than two unrelated building trades or crafts." A-General "solar projects on engineering jobs that do not involve buildings which house people, property, or chattel. Includes solar pools, hot tubs, spas, and separate solar arrays." C-4 "solar space heating utilizing a hot water holding tank." C-36 "solar hot water, pools, hot tubs, and spas." C-53 "solar swimming pools only." C-20 "solar space heating or solar air conditioning." C-61 "repair and maintenance of existing solar systems, may not install original systems."

June 30, 1980: In a letter to the CSLB Enforcement Committee members from the Office of the Registrar, it is clarified that the contractor's primary license [underlying the SC-44 supplemental class] "entitles him/her to work in [the area of the primary license] and not in a "supplemental area." Also clarifies that the SC-44 program was intended for "active solar mechanical systems" and "not intended for those who do building design and passive solar." The letter also acknowledges that the Board will "have to deal with technological advancements in photovoltaic cells."[33]

January 14, 1981: In a letter to the public from the CSLB Energy Division Chair Kathy Ryan, it states that CSLB is "in the process of evaluating the impact of photovoltaics on the construction industry." The letter asks that in order for CSLB to determine the "appropriate contractor license that may be involved in photocell installation, please send written comments." The letter states "obviously the appropriate license classification is C-10 but we are attempting to ascertain whether photocell installation requires additional experience, training, or other restrictions."[34]

March 2, 1981:[35] In a letter from Registrar John Maloney to Building Departments and Contractors, it states that "there has been confusion regarding the ambiguity in the SC-44 regulations" and that CSLB will be holding meetings to draft proposed changes to the regulations for discussion at April 1981 board meetings in order to propose regulations

by July 1981. Letter clarifies that "we've always interpreted the SC-44 to allow a contract for solar energy installations consistent with the scope of work of the primary classification" held by the licensee. The letter clarifies with an example, that "*e.g.*, a C-36 holding an SC-44 would be allowed to undertake solar contracts involving the use of plumbing skills, which includes solar pool systems, domestic hot water systems, and hot tub and spa applications," and that "B-Generals can do all solar work." The letter also reissued the December 1979 chart, referred to above.

April 9, 1981:[36] In a letter from the CSLB Energy Division Chair Kathy Ryan to the Enforcement Committee, it notes that "during the past two years of monitoring complaints and job reporting forms" (pursuant to the 756.3 regulation that required SC-44 contractors to report their projects to CSLB), staff have "found that the majority of contractors were working beyond the scope of their primary classification by undertaking all phases of solar installations." The letter notes that following meetings with industry, utility companies, building officials, and solar training institutions, that the SC-44 regulations "should be clarified." Specifically, that this means "developing a specialty solar license C-46 and eliminating the SC-44."

The letter clarifies that the rationale for eliminating the SC-44 in favor of developing the C-46 is due to the "large percentage of complaints involve business practice failure and ignorance of contractor's law," and notes that this is "problematic in an emerging field like solar where new companies must deal with rapidly developing technology and numerous state and local regulations related to solar energy installations." The letter further notes the fact that the "solar field is undergoing rapid change" and a new classification would allow for the "verifying [of] practical skills" and "emphasizing proven trade skills verified by employer certification, trade association certification, and educational experience." Finally, the letter notes that the "proper skill and experience" of the new classification would be "comprised of HVAC, electrical, plumbing, engineering, other associated trades, as well as an evaluation of any applicable educational courses."

September 1, 1981:[37] A CSLB rulemaking package is published, including a notice of proposed changes in CSLB regulations, and a Statement of Reasons. The package proposed repealing sections 756.1 (Creation of the Supplemental Classification), 756.2 (Qualifying Licenses for SC-44 Classification), 756.3 (Solar Reporting Requirement), 756.4 (Effective Date of Supplemental Class), and it printed the following amendments to the following license classifications (*underlines in original and highlight the change from the regulations as they existed in 1978*):

> **Amend 754.1 Class C-4 Boiler**, Hot-water Heating and Steam Fitting Contractors, amend existing classification to include language "including solar heating equipment"
>
> **Amend 754.10 Class C-53 Swimming Pool Contractors**, amend existing classification to include language "including installation of solar heating equipment"
>
> **Amend 746 Class C-20 Warm-Air Heating, Ventilating and Air Conditioning Contractors**, amend existing classification to include language "including systems utilizing solar energy"
>
> **Amend 734 Class C-36 Plumbing Contractor**, amend existing classification to include language "this includes the installation of solar equipment to heat the water to a suitable temperature for the purposes listed above"
>
> **Amend 733 Class C-10 Electrical Contractor**, amend existing classification to include language "solar photovoltaic cells or"
>
> **Amend 754.16 Class C-46 Solar Classification**, amend existing classification as follows: "A solar contractor is a specialty contractor whose contracting business is the execution of contracts or subcontracts requiring that specific art, ability, experience, knowledge, science and skill in designing, installing, modifying, maintaining, and repairing active solar energy systems. An active solar system consists of components which are thermally isolated from the living space for collection of solar energy and transfer of thermal energy to provide heating, cooling, or heating and cooling. Active solar systems include, but are not limited to, forced air systems, forced circulation water systems, thermosiphon systems, integral collector/storage systems, radiant systems, evaporative cooling systems with collectors, regenerative rockbed cooling systems, solar-assisted absorption cooling systems and solar -assisted heat pump systems. A licensee classified in this section shall not undertake or perform building or construction trades, crafts or skills except when required to design and install an active solar energy system.

In stating the rationale and purpose behind developing the stand-alone license, the Statement of Reasons for proposing the C-46 license explained that:

> Representatives from the plumbing industry…have stated that specific types of solar energy installations (e.g. hydronic systems) should be within the scope of Plumbing (C-36), and Boiler, Hot-water Heating & Steam Fitting (C-4) license classifications."[38]

> Representatives from the [sheet metal and HVAC] industries stated that specific types of solar energy installations (e.g. space-conditioning systems) be within the scope of their Warm-Air Heating, Ventilating and Air Conditioning Contractor (C-20) license classification.[39]
>
> A number of electrical contractors, solar photovoltaic firms, and the electrical industry association stated that a C-10 classification is the appropriate license for the installation of solar photovoltaic cells…currently, solar photovoltaic cells are not included in any of the existing regulations.[40]
>
> The use of solar heating systems for swimming pools presently represent the largest number of solar energy installations. The swimming pool license (C-53) allows a contractor to undertake or subcontract all phases of the construction of a swimming pool. The addition of a solar energy system for heating pool water is just another feature of this construction project. This is [supported by industry].[41]
>
> Testimony from various trade associations and general contractor associations indicates that all known active solar energy systems include aspects of at least three separate building trade skills and that certain active solar systems are within the meaning of a fixed work requiring specialized engineering, knowledge and skill.[42]
>
> The Contractors State License Board has received several letters from industry representatives stating that there are a minority of contractors who specialize in installation of all types of solar systems. Those contractors specializing in multiple or hybrid solar systems must have expertise that differs from the accumulation of the various specialty classifications which include specific solar technology. The Contractors State License Board, therefore, will take testimony on a separate solar classification.[43]
>
> Written correspondence and Contractors State License Board experience in handling consumer complaints relating to installation of solar systems attest to the fact that many consumer complaints involve insolvent or unlicensed contractors.[44]

December 10, 1981:[45] At a Special Meeting of the Board, Oakland, California, held in part to vote on the September 1, 1981 amendments, Board Member Warren E. McNely is selected to outline the Board's plan for the amendments. McNely states that "the problem with the current (SC-44) system is that there is no license for a specialist"; that "[a specialist would] have to get one of the core licenses if they want to just specialize in solar," which "results in a lot of people with the core license plus SC-44 working out of class."[46] McNely further stated, "there are a lot of people that, in good faith, have gone into this field and we feel a great obligation that we would not cause undue disruption." McNely then introduced the five steps that he articulated would be the plan for the amendment of the identified sections, as follows:

> "The first step…we amend the definition of the original classifications to include solar work. So what we're saying is, if you are a C-36, and we are willing to issue you a SC-44 because you held a C-36, let's put it into that classification so that you would be licensed

> to do that work without going to the added trouble of taking out an SC-44. This applies to five classes: C-4, C-53, C-20, C-36, and we're also proposing that the C-10 be added because there are increasing numbers of projects that are going to involve electrical and photovoltaic."[47]
>
> "Secondly, clarify that As and Bs can do work in existing statute. This is a statute that the Board itself has not determined. It's a legislative activity. I know that there will probably be another look at the As and Bs at a later date, but that is, we feel, beyond the purview of the Board at this point."[48]
>
> "Thirdly…we would like to stop issuing SC-44s at the time [that] the classifications that [currently] entitle a person [to have the SC-44] have the solar listed in their basic classifications [by regulation]. In other words, if you have a C-4 license, and the C-4 definition includes solar work, there's no point in then asking you to then get another license to restate that you can do solar work."[49]
>
> "Fourth…would be to establish the C-46 classification, which would be a solar license for solar specialists. There are a number of questions that have to be addressed in establishing this classification…We're proposing…we not resolve all those questions [now]…instead, we say that we are establishing this solar license classification at a date certain…that on January 1, 1983, we will have the C-46 license, and whatever criteria is established in the interim will be in effect."[50]
>
> "Step five would be the total elimination of the SC-44 classification…the end result will be that we will have the solar work defined in the basic classifications, plus a new classification which would be for solar specialists."[51]

The Board then proceeded to review the amendments to the classifications proposed in the September 1981 package above. The motion was unanimous to adopt 754.1, 754.10, 746, 734 and 733 as amended in the September 1, 1981 regulatory packet (see above).[52] The discussion then proceeded to the new proposed solar classification, 754.16, as it was presented in the September 1, 1981 package (see above). The Board confirmed the regulation is intended to "cover active solar only not passive."[53] The Board explained the intent to add "of air or water" to the words "or heating and cooling" in the 754.16 regulation and provided an explanation of the intent to eliminate the words "design" and "designing" from the classification.[54] Board Member McNely then clarified an unintended omission from the draft of 754.16 regulation, as it was presented in September 1, 1981, as follows:

> "We neglected to include in this proposed classification those electrical components [of solar systems]. It was our intent to do so. So…I'm proposing…we add, after the words that I previously asked you to write in ['*of air or water*'], 'heating and cooling of air and water or electricity.' This would be the collection and transfer of energy to provide those things. And then secondly, on the line where it ends, 'regenerative rockbed cooling systems,' [*add*] 'photovoltaic cells.'"

A motion was adopted to include Mr. McNely's amendments to Section 754.16 to include electrical and photovoltaic systems.[55]

April 28, 1982: Amendments were formally filed to repeal Sections 756.2 (Qualification for Supplemental Solar Classification), 756.3 (Solar Project Reporting Requirements), and 756.4 (Effective Date of Regulation), and to amend Sections 754.1 (C-4 Boiler, Hot-water Heating and Steam Fitting), 754.10 (C-53 Swimming Pool Contractors), 746 (C-20 Warm-Air Heating, Ventilating and Air-Conditioning Contractors), 734 (C-36 Plumbing Contractor), 733 (C-10 Electrical Contractor), and 754.16 (C-46 Solar Classification).[56]

This regulatory act did two things. First, it incorporated the changes to C-4, C-10, C-20, C-36 and C-53 classifications that added the solar construction to each classification, as presented in the September 1, 1981 regulation package and adopted at the December 10, 1981 special meeting. Secondly, it incorporated the amendments to Section 754.16 as presented and adopted at the December 10, 1981 special meeting, as follows: (*with strikethroughs and underlines to show the amended changes that occurred between September 1981 and December 1981*)

> **754.16**: A solar contractor is a specialty contractor whose contracting business is the execution of contracts or subcontracts requiring that specific art, ability, experience, knowledge, science and skill in ~~designing,~~ installing, modifying, maintaining, and repairing active solar energy systems. An active solar energy system consists of components which are thermally isolated from the living space for collection of solar energy and transfer of thermal energy to provide heating, cooling, heating and cooling **of air or water, or electricity**. Active solar energy systems include, but are not limited to, forced air systems, forced circulation water systems, thermosiphon systems, integral collector/storage systems, radiant systems, evaporative cooling systems with collectors, regenerative rockbed cooling systems, **photovoltaic cells**, and solar-assisted absorption cooling systems ~~and solar -assisted heat pump systems~~. A licensee classified in this section shall not undertake or perform building or construction trades, crafts, or skills except when required to ~~design and~~ install an active solar energy system. The C46 classification will be issued on or before 1/1/83 after approval by the Board in a public meeting of a qualification procedure developed by the Registrar.

June 8, 1982:[57] In a memorandum to all staff from CSLB Energy Division Chair Kathy Ryan entitled "Solar Licensing Changes Go into Effect," it states that the "solar regulations adopted by the Board December 1981 were approved by the State Office of Administrative Law and became effective May 22, 1982." The memorandum clarifies that after the C-46 license begins being issued, "any contractor who wants to do solar

work outside the scope of the license classification he/she holds will have to apply for a C-46 license or additional licenses depending upon the type of solar work they undertake."

August 25, 1983: Amendments are formally filed to amend Section 754.16 (C-46 Solar Contractor Classification), as follows:[58] (*with strikethroughs and underlines to show the amended changes that occurred between June 1982 and August 1983*)

> **754.16**: 754.16 Class C-46 Solar Classification: a solar contractor ~~is a specialty contractor whose contracting business is the execution of contracts or subcontracts requiring that specific art, ability, experience, knowledge, science and skill in installing,~~ **installs**,~~ modifying,~~ **modifies**, ~~maintaining,~~ **maintains**, and ~~repairing~~ **repairs** active solar energy systems. An active solar energy system consists of components which are thermally isolated from the living space for collection of solar energy and transfer of thermal energy to provide **electricity** ~~heating, cooling,~~ and/or heating and cooling of air or water~~, or electricity~~. Active solar energy systems include, but are not limited to, forced air systems, forced circulation water systems, thermosiphon systems, integral collector/storage systems, radiant systems, evaporative cooling systems with collectors, regenerative rockbed cooling systems, photovoltaic cells, and solar-assisted absorption cooling systems.
>
> ***[ ]***
>
> A licensee classified in this section shall not undertake or perform building or construction trades, crafts, or skills except when required to install an active solar energy system. The C46 classification will be issued ~~on or before 1/1/83~~ after ~~approval by the Board in a public meeting of a qualification procedure developed by the Registrar."~~ **development of an examination**.

April 20, 2009: The CSLB holds a regulatory hearing on the following proposed amendments to the C-46 Solar Contractor license classification.

> A solar contractor installs, modifies, maintains, and repairs **thermal and photovoltaic** ~~active~~ solar energy systems. ~~An active solar energy system consists of components which are thermally isolated from the living space for collection of solar energy and transfer of thermal energy to provide electricity and/or heating and cooling of air or water. Active solar energy systems include, but are not limited to, forced air systems, forced circulation water systems, thermosiphon systems, integral collector/storage systems, radiant systems, evaporative cooling systems with collectors, regenerative rockbed cooling systems, photovoltaic cells, and solar assisted absorption cooling systems.~~
>
> A licensee classified in this section shall not undertake or perform building or construction trades, crafts or skills, except when required to install a~~n active~~ **thermal or photovoltaic** solar energy system. ~~The C46 classification will be issued after development of an examination.~~

The initial statement of reasons for the regulatory package explains:[59]

> The existing regulation sets forth the scope of work for a C-46 Solar Contractor as it relates to the installation, modification, maintenance, and repair of specific types of active solar energy systems.
>
> The proposed amendment is being made in order to update the definition of a C-46 Solar Contractor by deleting text that refers to specific and in some cases outdated types of solar energy systems. Instead, the definition would simply refer to thermal and photovoltaic solar energy systems to allow for new innovations that would also meet this definition.
>
> This regulation is necessary to update the definition of a C-46 Solar Contractor.

The final statement of reasons details a single public comment and the Board's response thereto, as follows:[60]

> **Comment #1:** In his written comments, John Lloyd recommended that the Board modify the language of Section 832.46 further to require that only "certified electricians" be authorized to perform the connections from panels to the inverter and building. He also recommended that persons "having direct contact with the Photovoltaic panels in the mounting of racking and installing of the panels at least be in an indentured apprenticeship program and the connections from the array to the buildings be performed by a certified electrician.
>
> **Response to Comment #1:** Mr. Lloyd's recommendations are not consistent with existing rules and regulations. Business and Professions Code Section 7059 (a) contains a provision that allows contractors to perform work that is "incidental and supplemental to the performance of the work in the craft for which the specialty contractor is licensed." In addition, CCR Section 831 defines the phrase "incidental and supplemental" as work that is "essential to accomplish the work in which the contractor is classified. Therefore, the changes recommended by Mr. Lloyd will not be made because they would be inconsistent with the existing language contained in one of the reference statutes and an existing regulation.

December 30, 2009: The CSLB formally amends the C-46 Solar Contractor license classification[61] (Title 16, Division 8, Article 3, § 832.46 of the California Code of Regulations). After the amendment (and through present day), the classification now reads:

> A solar contractor installs, modifies, maintains, and repairs thermal and photovoltaic solar energy systems.
>
> A licensee classified in this section shall not undertake or perform building or construction trades, crafts, or skills, except when required to install a thermal or photovoltaic solar energy system.

SECTION THREE:

Public Participation Hearings and Industry Stakeholder Meetings

January 2019 Industry Expert Meetings

On January 17 and 18 of 2019, CSLB staff hosted meetings of C-10 Electrical Contractor industry experts and C-46 Solar Contractor industry experts, respectively. The focus of both meetings was to discuss the technical requirements and safety risks of the installation of energy storage systems (ESS) paired with solar photovoltaics (PV). Comments from the presenters at each meeting are summarized below.

January 17, 2019 C-10 Industry Expert Meeting

Battery ESS is a separate system than a solar PV, subject to separate codes, safety risks and installation. Both are a "distributed energy resource; a battery does not generate energy, rather it is a "load" that consumes energy. Industrial-scale solar installations use the most modular ESS units, followed by residential scale installations, and commercial application has the fewest modular units. Whether residential or commercial, calculations are required to ensure the existing electrical system can withstand installing an ESS. To prevent overloading, residential and commercial systems will usually require a service upgrade; approximately 20% of installations require a service upgrade, due to the installation of equipment such as an electric car charger or PV system that exceeds the energy threshold of the service panel. Most batteries installed by C-10 contractors are AC coupled; DC batteries are used to install solar and require an inverter.

As for safety, the same steps and precautions are taken to ensure installations are done safely and to code, no matter the scale. Batteries and their components generate fault currents, which must be coordinated properly to protect equipment and persons. The more batteries connected in a series, the more fault currents created. Anything over 50 volts is considered life-threatening, and solar PV ranges from 17 to 1,500 volts. Commercial is up to 1,000 volts with 800-volt batteries and utility scale is 1,500. On large scale systems the fire department must approve ESS and its design; there are measures implemented for fire departments to do emergency shut downs of systems. Under current law, B Contractors can install solar PV paired with ESS but it is

recommended they subcontract to C-10s. Technology has changed and lithium-ion batteries are more commonly used now than lead-acid. Each battery type has their safety concerns depending on the "set up and management" and poor installation can increase battery safety risks.

January 18, 2019 C-46 Industry Expert Meeting

The battery ESS most commonly used in the market are "plug and play," comparable to a simple appliance installation. With larger systems, the batteries are manufactured with the system and arrive as a "modular" unit. The same type of battery is generally used in residential and commercial and the number of modular units for a system depends on the energy demand. Distinguishing by commercial, residential, or industrial systems is difficult because energy needs, the building, and system size vary (e.g. a large residence can require bigger ESS than light commercial). This industry has been installing batteries for the last 40 years and in many ways lead-acid is more dangerous than new lithium ion enclosures. There are many components to "PV system," but one inverter makes the whole thing operate as a system. Manufacturers are building PV systems to include battery ESS because of the increase in demand. The steps for installation at the commercial level is the same as residential, the steps simply take longer. One permit is required to install a solar system and a battery.

As for safety, the "plug and play" systems at the residential and commercial level have circuit protections built in that preclude the arc flash and thermal runaway. While battery cells can deliver high fault currents that can spark from blunt impact, installers do not have access to the terminals, as a safety measure by the manufacturer. A PV system can be connected to a service panel but there is a 20% output limit to prevent overloading the panel. If the equipment must be upgraded, it is usually to the service equipment; approximately 20% of PV installs require a service panel upgrade. Most new homes have an "all in one" service panel that includes the meter and breaker. Utilities determine if service upgrades are required and a C-46 will subcontract a full-service upgrade. A C-46 would not install a standalone ESS job that would typically be performed by C-10 or B contractors. Approximately 70% of PV is installed by union

electricians mostly for commercial and industrial jobs. Having a certified electrician is beneficial when working with PV and energy storage.

April 2018 Public Participation Hearings

On April 25 and 26, 2018 Contractors State License Board (CSLB) staff held a two-day public participation hearing at its headquarters in Sacramento. The purpose of the hearing was to take testimony that would assist in the CSLB review of its current determination of the appropriate license classification(s) to install an energy storage system (ESS) either in a stand-alone contract or when included in the installation of a solar photovoltaic (PV) system.

A total of seventy-one people testified over both days. Forty-six people testified on day one and twenty-five people testified on day two. The tables below summarize the seventy-one comments by each speaker with the speaker's conclusion (if one could be identified). The tables are divided into the following categories of speakers, based on how the speakers identified themselves: (1) Electrical Training Instructors; (2) Certified Electricians or Electrical Apprentices; (3) Contractors; (4) Labor/Contractor/Utility Representatives; (5) Fire / Inspection / Safety; (6) Other Specialist / Unknown.

The tables indicate that 63 people testified in support of ESS systems being installed by C-10 contractors employing certified electricians (CE) regardless of whether as a standalone system or part of a PV system install. All speakers representing the training instructors, electricians, apprentices, fire, inspection, or safety groups spoke in favor of this conclusion. One contractor identified as a C-10/C-46 license holder recommended the Board conduct more research. Two other licensed contractors holding C-10, C-46, A, and B licenses did not express direct conclusions. One C-10/C-46 license holder testified that C-46 contractors are the most experienced and trained in battery ESS paired with PV. Three solar contractor representatives testified in support of allowing C-46 contractors to install solar PV paired with ESS.

The following table summarizes the comments and conclusions of the speakers who identified themselves as instructors or teachers in the electrical training industry.

ELECTRICAL TRAINING INSTRUCTORS				
#	Speaker # / Day	Speaker	Conclusion	Comments
1.	1 / 1	Master Instructor	C-10 with CEs install ESS only	PV and ESS are separate systems. Subject to separate codes and separate safety risks (shock, fire, flash burns, explosion, chemical exposure). C-46 employees don't have the same training of C-10 employees.
2.	19 / 1	Training Director	C-10 with CEs install ESS only	ESS has become integral part of industry. Apprenticeship training will soon include training on safety and installation of ESS and microgrid.
3.	21 /1	Assistant Training Director	C-10 with CEs install ESS only	*Extensive testimony on the content of training that California electrical apprentices receive* (five years, 1,200 hours instruction from CE trainers, electrical theory, interconnection of batteries and power sources, safe work practices, Cal OSHA and NFPA safety requirements, 8,000 hands-on under C-10s, pass exam, continued education)
4.	23 / 1	Training Director	C-10 with CEs install ESS only	Only employees of C-10s meet the California definition of "qualified person" for the NFPA (National Fire Protection Association) and NEC (National Electrical Code) for electrical safety. They are trained on the likelihood of dangers and how to respond.
5.	37 / 1	Apprenticeship Instructor	C-10 with CEs install ESS only	Battery room is most dangerous area in commercial solar PV power plants. Technology is changing, we're improving wattage per square foot on panels, voltages higher and higher, batteries have to match that. Lithium-ion currently state of art, and that will be changing soon as well. Only employees of C-10 have qualifications to manage these systems.
6.	38 / 1	Apprenticeship Instructor	C-10 with CEs install ESS only	ESS is not new or evolving technology we've been installing them for decades. They are installed to take load off peak or shave peak load down for customer. The C-46s that do ESS all have a C-10. If they do ESS without C-10 they've broken the law.
7.	42 / 1	Instructor	C-10 with CEs install ESS only	OSHA 10 is a must-have certification for anyone performing electrical work or working on a construction site. Apprentices learn DC theory, what batteries operate on, what happens when you put sources in a series versus parallel
8.	48 / 2	Electrical Training Director	C-10 with CEs install ESS only	*Extensive testimony on the content of training that California electrical apprentices receive* (first year includes safety training, DC v. AC, second year classroom and hands-on in PV, inverters, AC, third year DC semiconductors, electronics and power sources, fourth year, frequencies and power conversion, all five years 1,000 hours classroom, 8,000 on job.) DC is letters of alphabet, AC is writing an essay. CEs have to know both.
9.	49 / 2	Training Director	C-10 with CEs install ESS only	Trainers recently went through 45 hours of ESS microgrid training and certification. Shorting out of terminal on lithium-ion battery can generate 1,200-1,750 instantly. When sealed in case, arc flash of between 30k-60k degrees, just one battery. If they are stacked, e.g. at a residence, it's a series of bombs. ESS not just "plug and play" like solar panels that are just connected in series; if you make a mistake across the phases, will explode, a thermal runaway.
10.	66 / 2	Apprenticeship Instructor	C-10 with CEs install ESS only	Since high-energy ESS are already energized when connecting a few together they meet OSHA requirements of energized work permits and procedures that must be followed. Proper safety, rigging, termination, torqueing techniques must be followed to install. Apprentices learn this.

The following table summarizes the comments and conclusions of the speakers who identified themselves as certified electricians (CE) or as midway through an

apprentice program. Some CEs in this table indicated they worked for licensed contractors but did not identify those contractors.

CERTIFIED ELECTRICIANS (CE) OR ELECTRICAL APPRENTICES				
#	Speaker # / Day	Speaker	Conclusion	Comments
1.	2 / 1	Certified Electrician	C-10 with CEs install ESS only	CE training includes labeling wires properly so if you are assigned to a different task, someone else can pick up where you left off behind you. Electrical industry is dangerous.
2.	3 / 1	Electrical Apprentice	C-10 with CEs install ESS only	Worked under C-10 and C-46. Under C-46 "thrown out in field, learning as you go." Received more training working under a C-10.
3.	7 /1	Certified Electrician	C-10 with CEs install ESS only	In ESS when you try to contain energy into a small point it wants to escape: either slow, regulated trickling, or thermal runway. Catastrophic event involving battery breakdown and melting everything. Must understand hazards with crossing the 48V threshold.
4.	10 / 1	Electrical Apprentice	C-10 with CEs install ESS only	ESS and PV systems have their own codes because its not just batteries, when you tie into electrical grid engaging loads requirements need to be met. CEs are trained on that. Batteries more complex and demanding on utility level, larger capacities, higher voltages.
5.	12 / 1	Certified Electrician	C-10 with CEs install ESS only	Discusses history of CE requirement and purpose of NFPA is safeguarding persons and property from hazards of electricity. If you install batteries, can you install electrical systems in building that house rack? What if new switchgear required? Disconnects, controls, underground, feeders, if C-46 does this need C-10 so they can use CEs.
6.	15 / 1	Certified Electrician	C-10 with CEs install ESS only	Experience with C-46 installing PV on home, C-46 did not know difference between grounded conductor and grounding conductor. Purpose of NEC is safeguarding people and purport from hazardous. C-46s not qualified like CEs.
7.	16 / 1	Certified Electrician	C-10 with CEs install ESS only	Having worked for both C-46 and C-10 witnessed firsthand amount of training that goes into safety of installing ESS. CEs evolve as the technology evolves.
8.	18 / 1	Certified Electrician	C-10 with CEs install ESS only	There are many types of ESS, batteries, and types of batteries, lead and nickel cadmium, fuel cells, flow batteries, hydro generation. They pose risk to utility workers when connected to grid. All can be connected with PV or separate.
9.	20 / 1	Electrical Apprentice	C-10 with CEs install ESS only	Failure to follow NFPA and OSHA guidelines can result in injury. A non-CE cannot recognize the hazards involved in PV plus storage, such as shock hazards up to 12k degrees Celsius.
10.	26 / 1	Certified Electrician	C-10 with CEs install ESS only	Speaker presented a suit of a type worn two years previously that saved this speaker's life, while working on an energy backup system installing a meter-read to read a meter that someone else installed.
11.	31 / 1	Certified Electrician	C-10 with CEs install ESS only	DC systems are greatly expanding. When seemingly simple batteries connected together as complete system, high voltages and arc energy rival AC systems they are integrated with. DC power systems arguably more dangerous than traditional AC systems because they can't be shut off at panel. ESS systems are on all the time.
12.	33 / 1	Certified Electrician	C-10 with CEs install ESS only	Solar PV and battery storage is ever-changing technology. The more MW, the more complex. Solar panels generally produce about 30-35 volts, a couple of amps, and there is no on-off switch. Shock from a solar panel mildly uncomfortable. Batteries are an add-on, not limited to solar, lithium-ion of 2 two volts can produce 1,700 amps. Must know whole NEC to understand batteries.

13.	34 / 1	Certified Electrician	C-10 with CEs install ESS only	Difference between C-10 and C-46 is standardized training, working with other professionals beside you and chain of command with years of knowledge. At every level experience and knowledge to get job done safely.
14.	35 / 1	Certified Electrician	C-10 with CEs install ESS only	Solar PV and ESS are separate, distinct systems. Witnessed PV being installed on home of family member by solar company, system not grounded properly and not supported. Was able to show contractor in NEC where wrong.
15.	36 / 1	Certified Electrician	C-10 with CEs install ESS only	Solar PV and ESS are separate, standalone systems that are complex in nature. Just because an ESS is adjacent to solar facility does not mean solar contractor can install any more than a cement mason can finish the concrete dome around a reactor can build the reactor.
16.	41 / 1	Certified Electrician	C-10 with CEs install ESS only	Before becoming CE, worked for a C-46 as a temp employee on 1.1 MW solar install at a Costco, installed 2,500 panels. They were energized and had a voltage differential. Therefore, speaker was terminating wires with no experience and no idea about voltage differential; one path it can take is through the body.
17.	45 / 1	Certified Electrician	C-10 with CEs install ESS only	C-46 contractors are going to create an underground economy that is going to have a direct impact on CEs.
18.	46 / 1	Certified Electrician	C-10 with CEs install ESS only	C-46 contractors lack experience in electrical industry.
19.	47 / 2	Certified Electrician	C-10 with CEs install ESS only	Electrical work is inherently dangerous and requires more than just instructions to produce it safely. Times change and citizens of the state want only well-trained people to install electrical equipment of any kind. Mistake to allow C-46 to continue and/or expand their scope of work to ESS.
20.	54 / 2	Certified Electrician	C-10 with CEs install ESS only	C-46 contractors can pay their workers minimum-wage and have no experience to do the install. C-10 employees have 8k hours work just to take a taste that over 50% fail. CSLB should look at turnover for C-46 employees versus CEs and see if cost is why the C-46 doesn't get the C-10
21.	55 / 2	Certified Electrician	C-10 with CEs install ESS only	Experience with DC and battery backup systems for schools, data centers, hospital. Each one is different in installation and operations. Requires strong education in fundamentals of electricity, DC and AC, to work on variety of ESS
22.	62 / 2	Certified Electrician	C-10 with CEs install ESS only	Because you have a driver's license, does that entitle you to drive a bus? No. If you're a dental hygienist, do you perform root canals? No. Because you can fly a Cessna, does that mean you fly a commercial airline? No. Should a non-CE working for a C-46 be able to install and maintain ESS? No.
23.	67 / 2	Certified Electrician	C-10 with CEs install ESS only	On one hand, highly skilled guys doing ESS for years (C-10), and the other hand less skilled, less trained with less experience (C-46). They should be excluded because of potential hazards.
24.	68 / 2	Certified Electrician	C-10 with CEs install ESS only	In the utility industry, the battery backup mazes we have are for whole substations. They are kept in separate buildings, explosion-proof fittings with separate codes because of dangers. Should be cautious of lithium-ion battery or lead acid battery installed at school or hospital or home.

The following table summarizes the comments and conclusions of the speakers who identified themselves as contractors. Some, but not all the individuals in this category identified themselves as the license qualifier (the individual with the knowledge and experience who took a licensing exam) for a CSLB license. Others in this category identified themselves as a certified electrician. However, all the speakers in this category identified themselves as working in a high capacity (director, manager, officer)

for an identified licensee, which is why they were included in this table (despite not all of them identifying themselves as the license qualifier).

CONTRACTORS				
#	Speaker # / Day	Speaker	Conclusion	Comments
1.	5 / 1	C-10	C-10 with CEs install ESS only	There is no "plug and play" on interconnection of an electrical panel. It requires drilling hole in live panel, installing conduit, pulling wire, landing on a breaker on a live busbar.
2.	6 / 1	C-10 / C-46	Further research needed / establish a committee	There are many kinds of ESS (like hydrogen, solar pumps, water pumps) many of which can be paired with PV. No rational reason to limit installation by KW or by KV or by storage. Lithium-ion LiPo is one of safest ESS out there. It is "kind of crazy" to say C-46 is not qualified. CSLB needs to have a committee to look into this further.
3.	9 /1	C-10	C-10 with CEs install ESS only	*Spoke of three utility-scale projects installed*. Have installed projects over 10 MW batteries operating over hundreds of degrees, over 1,000 volts DC with 15KV inverters. Projects more than just battery, includes communications, relays. They are all very unique and take competencies in more than one electrical discipline.
4.	11 / 1	C-10	C-10 with CEs install ESS only	Things coming out nowadays are coming out faster than the codes can address them. Article 706 in NEC (dealing with ESS) is not in the current code that's in the 2017. We are looking at more than just battery plus PV but on utility scale here. Codes are only just evolving to cover all this, and only CEs are trained in it all.
5.	17 / 1	C-10 / C-46	C-10 with CEs install ESS only	We win projects that qualify for both licenses but don't put C-46 employees on battery ESS because they aren't trained or educated. It is more than plug and play, you are migrating circuits, actual electrical work. It isn't just the license holder doing this work its employees. Storage requires more than PV part of project.
6.	22 / 1	C-10 / C-46	C-10 with CEs install ESS only	Licensee has installed 8k plus residential jobs over 60MW of power and installed 60 plus residential ESS and backlogged with 50-60 more. Recently 23 units had to be recalled from homes and replaced. There are manufacturing kinks to work out.
7.	30 / 1	C-10	C-10 with CEs install ESS only	ESS and PV are separate systems with their own technical requirements, codes, and hazards. Most battery ESS operate near 1k volts DC, much different than 5 years ago. They are growing and can be combined to support many homes. One minor installation error can create arc fault or short circuit that can cause fire.
8.	32 / 1	C-10 / C-46 / A / B	No direct conclusion expressed	Regarding the voltages and currents of ESS plus PV versus solar PV only, over the past 2-3 years voltages and currents that are present on ESS have become more and more in line with the solar-only grid-tied industry. In residential, it's a 600-volt DC limit. In commercial and industrial is 1,000-volt DC. The ESS products coming out are in line with these expectations. The challenges facing a C-46 in dealing with these voltages is very similar to the last 20 years. There is essentially no change to the consumer in delivering products and components they're used to. And even if they're considered separate systems, CA is seeing attachment rates at 50% and Hawaii is at 100%. They're combined systems by policy and demand.
9.	51 / 2	C-10	C-10 with CEs install ESS only	Many of our projects result in output of 240 to 480 volts and if grid-tie, voltages even higher with very special connections need to be made. They are extremely dangerous requires proper training. Installing PV and plugging them together is far different than constructing and connecting battery ESS.
10.	53 / 2	C-10	C-10 with CEs install ESS only	Battery ESS is much more complex than PV and provide functions beyond converting sunlight to power. They can be installed in combination with PV or without, independent of PV and independent of the grid. NEC has separate code articles for each system, and the CA fire code regulates batteries different than PV. Lithium batteries are prone to thermal escape if installed incorrectly. An ESS is never a requirement for installing a PV; they're separate systems.

11.	56 / 2	C-10	C-10 with CEs install ESS only	Risk factors increase exponentially when connecting sizable solar arrays to the larger overall system. Although PV and ESS can be paired, they are separate systems per the NEC and at the disconnect. Risks of electric shock, fire, flash burns, explosion, chemical hazard exposure. Battery banks must be electrically isolated when working on them. Risk varies depending on battery type and size.
12.	57 / 2	C-10	C-10 with CEs install ESS only	Company does solar installations at schools, airports, hospitals. Each project requires detailed interconnection to existing building power source or grid. 1 MW rooftop solar project spread over 70k square feet versus 1MW battery system in a container over less than 500 square feet gives you a sense of the difference in potential energy danger. It is becoming more common for battery and storage to be on the same project, but they do not need to be installed together to operate.
13.	58 / 2	C-10	C-10 with CEs install ESS only	NEC is trying to keep up with this new technology. Now that ESS is available for general public must minimize hazards. C-10 covers energy storage, C-46 does not.
14.	59 / 2	C-10	C-10 with CEs install ESS only	ESS and PV can be paired together but are separate systems subject to their own code, installation, and fire safety standards. NEC provides in 690.1B that PV install ends at system disconnect. ESS is a separate electrical system covered under section 706. They also pose very different fire and safety risks. Higher ESS capacities have higher risk of arc flash. Must be qualified to install.
15.	60 / 2	C-10 / C-46	No direct conclusion expressed	C-46s are not here to hurt anyone. We learn from other people, we get the certifications, we learn how to do things properly, follow plans, get approvals, we must follow the same rules. We do have training. C-46s are not a fly-by-night operation. It will kill the business for small installers if they think they need a C-10.
16.	61 / 2	C-10	C-10 with CEs install ESS only	The workers are the ones who install these systems while contractors are employers who run the business. Lead acid batteries are not the same as lithium-ion batteries. A 7kw solar system produces 7k watts but a battery ESS stores the energy produced by these arrays, meaning up to 56kw. And the system can only deliver the power it is producing at a moment in time. Battery storage under a direct fault can deliver all its stored energy at once. It's a big difference.
17.	69 / 2	C-10 / C-46	C-46 are the most experienced and trained on battery ESS	Assisted in development of C-46 license exam, which is very focused on energy storage. Solar customers have historically needed batteries when the sun doesn't shine so C-46 contractors are trained and tested on batteries because that's what customers need. Took the C-10 test and there were no battery storage questions. Lithium ion batteries won't be in CA codes until 2020. PV voltage is 400 volts, and popular lithium ion batteries run at 400 volts DC. Solar installers have worked with this voltage for 20 years. When connecting these systems, the terminals are not live because there are circuit breakers. If the terminals are shorted, the breaker trips. There can be no fire, no explosion, no arc flash. These are the systems that are going in homes and businesses.

The following table summarizes the comments and conclusions of the speakers who identified themselves as representatives of various industries, to include labor, contractor or utilities.

. LABOR / CONTRACTOR / UTILITY REPRESENTATIVE				
#	Speaker # / Day	Speaker	Conclusion	Comments
1.	28 / 1	Representative – Electrical Contractors	C-10 with CEs install ESS only	If C-46 are not allowed to do standalone ESS why should they be allowed to install as part of a PV system? These are not separate systems. They are not comparable to the small car batteries installed with PV 25 years ago. A few questions on a test does not qualify you to install complex systems. A C-46 should not be able to employ CEs because they don't have CE training.

2.	29 / 1	Representative – Electrical Workers	C-10 with CEs install ESS only	The last thing we want is our members to show up on the job after a storm or fire and these systems aren't working correctly. They need to be installed, maintained properly so they don't have to worry about something taking their lives. OSHA requires employees must receive instructions for how to work on these systems.
3.	39 / 1	Representative – Electrical Contractors	C-10 with CEs install ESS only	No one besides a C-10 should install ESS because of the potential for injury and accidents is much higher when the products involve DC currents at higher voltages than normally dealt with on jobsites. The work has to abide by the NEC so it should be done by a CE.
4.	40 / 1 and 67 / 2*	Representative – Solar Contractors	C-46 can install ESS paired with PV	There is no evidence of widespread health or safety issues in this marketplace. Restricting all solar and ESS paired systems to a C-10 limits the workforce and disrupts hiring practices and knocks out some of most qualified contractors. 100k systems installed in 2017, 69% hold C-10 and 62% hold C-46. Of that 110, eleven hold a C-10 only. There is no significant difference in residential and commercial markets. CAL/OSHA requires all licensed contractors with 3 or more employees to document and certify everyone on staff is properly trained in accordance with the California Electrical Code. Of over 200 PV plus solar systems interconnected by PG&E since 2013 and over 4kw, the majority installed by C-46. This is not new technology or an expansion of technology.
5.	43 / 1	Representative – Solar Contractors	C-46 can install ESS paired with PV	Our association pushed for C-46 examination in 1980 because only a few mechanical trades were allowed to do it at the time, the C-10 was not even included because it was all solar thermal back them. Many of our people have the NEC and CEC on their desk, which supersedes the NEC. The C-46 are trained in the codes and by the ESS manufacturers who train us on their technology. Governor Brown is building a house with PV and storage installed by a C-46. If C-46 installs an ESS and is no longer allowed to maintain it does this void warranty? C-10s will need to buy those warranties.
6.	44 / 1	Representative – Electrical Contractors	C-10 with CEs install ESS only	*Extensive testimony about labor, work force development and electrical worker market demand.* As this technology matures and proliferates, particularly within the dense urban environments of our load centers, CSLB will play a central role in determining whether those installing it have safety training and skills that sets the competitive dynamic around lowest price and lowest wages.
7.	50 / 2	Representative – Utility Company	C-10 with CEs install ESS only	Oppose to expanding C-46 licenses to ESS and urge requiring only contractors qualified to install ESS as stand-alone projects to install ESS paired with PV. The maturing technology must be installed by the highly skilled and trained
8.	52 / 2	Representative – Solar Contractors	C-46 can install ESS paired with PV	C-46 exams test heavily on battery ESS. We have not seen statistics or evidence that C-46 are ill-equipped to install PV plus storage. CA is not only state to offer solar installer license like C-46. Some of the largest solar markets in country include Nevada, Connecticut and Florida. Solar plus PV installed by solar contractors is not unique or new to California.
9.	63 / 2	Representative – Electrical Contractors	C-10 with CEs install ESS only	C-46 regulation clearly restricts to thermal and PV solar energy systems and shall not undertake other skills except when required to install PV. An ESS is not required to install PV. CSLB report should include (1) number licensees holding C-10 and C-46 (2) number of NEC and NFPA questions on both exams (3) number of complaints against C-46; (4) determine which industries have approved training programs for installation of ESS; (5) who is best suited to protect consumers
10.	64 / 2	Representative – Utility Employees	C-10 with CEs install ESS only	Fire and electrical codes treat systems as separate because they're located in different areas of the occupancy, subject to different codes and standards, pose different safety works. Fire code has specific requirements about ESS when they are put in their own room. All available configurations of PV plus solar in the codes have them as separate systems. Solar PV generates and exports but does not store energy. ESS does not generate energy but it stores and discharges energy. Storage makes them more hazardous. On the customer side we're seeing commercial systems that are now 10 to MW which is essentially utility scale.

11.	65 / 2	Representative – Contractor Labor	C-10 with CEs install ESS only	C-10 contractors have done DC and ESS work since the 50s and 60s. What is on the exam does not matter because it is the workers who install these systems for C-46s. It is the workers that lack the skill, training, and certifications.

*Representative spoke twice, once on day one, once on day two. Comments on both days summarized here.

The following table summarizes the comments and conclusions of the speakers who identified themselves as representing the firefighting industry, inspection or safety industry. The one individual who identified himself as a safety professional indicated that he only worked with electrical safety. The one individual who identified himself as an inspector did not specify what kind of inspector.

FIRE / INSPECTION / SAFETY				
#	Speaker # / Day	Speaker	Conclusion	Comments
1.	4 / 1	Fire Chief	C-10 with CEs install ESS only	These systems are varied, they're massive, and they take a lot of technical expertise to manage. They're growing in proliferation in our community and the technical expertise that it takes to work on the systems is high level.
2.	13 / 1	Firefighter	C-10 with CEs install ESS only	C-46 installers have long history of safety in low voltage flooded cell ESS. But introduction of new chemistry and new technologies requires re-look at the requirements. Lithium-ion chemistry hazards are not completely understood. There is a need for expanded licensing and education requirements of installers. PV and ESS are separate systems. They are more integrated on residential side but on the utility side it is complex and high level requiring significant electrical engineering.
3.	14 / 1	Inspector	C-10 with CEs install ESS only	Batteries are inherently safe. They are made to be safe. But if you do not know what you are doing, they are dangerous. Especially the larger scale batteries. You do not want people putting them in that don't know the NEC or what's going on.
4.	25 / 1	Fire Prevention Officer	C-10 with CEs install ESS only	The C-46 classification description specifically prohibits installation of trades, crafts and skills not required to install PV. The C-46 should not be expanded to ESS. They require separate knowledge, skills, and abilities.
5.	27 / 1	Safety Professional	C-10 with CEs install ESS only	The safety concern with batteries is energy potential, even in smaller ESS. Electrical shock, hazardous voltages, arc flash if short-circuited, temperatures above 35k degrees. Higher the storage capacity higher the risk. Fire and exposure, hazardous gas, electrical overload, damaged battery casing ruptures. Safety concerns during installation can be followed to prevent this if trained.

Finally, the following table summarizes the comments and conclusions of the speakers who identified themselves as having some other special knowledge or experience, or they did not identify themselves at all.

OTHER SPECIALIST / UNKNOWN				
#	Speaker # / Day	Speaker	Conclusion	Comments

1.	8 / 1	Plant Operator	C-10 with CEs install ESS only	Owner-operator of large industrial battery systems. MW level battery systems require control systems in large central energy plants. The most dangerous room in the house is the battery room. Background in electrical theory is basis for working on these. Inspections of these area takes two days.
2.	24 / 1	Electrical Engineer	C-10 with CEs install ESS only	These are DC voltages. Volts are free, amps are expensive – which means the higher the voltage, the lower the current, the smaller the conductors, changes all your switches. When that happens there are dangers. Amp interrupting capability or vault current. When the fuse arrives out in the field, someone must be able to read the label and understand what they're putting in. Especially utility scale.
3.	70 / 2	Unknown	No conclusion expressed.	So far focused on one technology and application. The Board needs to look at the five different types of ESS. Pumped hydro, mechanical, thermal, electrochemical, and that there's prefabricated systems and non-prefabricated systems. make sure when you make a ruling on energy storage, you're considering this.
4.	71 / 2	Unknown	C-10 with CEs install ESS only	Electrical work should stay in the hands of the qualified, licensed, state-certified electricians.

SECTION FOUR:

Survey of Building Departments

This section of the report summarizes information, statements, and survey responses the Contractors State License Board (CSLB) has received from individuals on behalf of local building departments.

Letter from California Building Officials Association

In response to its announcement that it would host a public participation hearing on the appropriate classifications to install an Energy Storage System (ESS) in a standalone contract or when included in the installation of a photovoltaic system, the Contractors State License Board (CSLB) received a letter from the association of California Building Officials (CALBO), dated April 25, 2018. The Letter states that CALBO members are primarily responsible for enforcing building code requirements in an estimated 95% of the buildings constructed in the state. The letter states that CALBO "support[s] a C-10 classification as the most appropriate for installing an ESS" and that the C-10 classification "has the proper training and expertise in order to provide the required safety measures and ensure proper code compliance." The letter further states that "allowance of a C-46 licensee to perform this job function could jeopardize the integrity and safety of the ESS unit and jeopardize the safety of those within the dwelling" and that the C-46 license "does not have the proper training or experience to comply with current installation requirements."

County Building Official Annual Business Meeting

On May 2, 2018, CSLB Board Member Nancy Springer and Registrar David Fogt met with more than 30 county building officials and received general information regarding the installation of energy storage systems (ESS). In summary, the officials' comments indicated that the license classification causing the officials the most ESS installation concerns is the B-General Building Contractor classification. Many of the officials for the various counties indicated that the counties require a C-10 Electrical Contactor license to upgrade the electrical panel, which is often necessary for an ESS installation. Finally, officials at the meeting noted that code and trade standard compliance depend on the use of trained electrical workers to perform ESS installations.

CALBO Solar-Related Code Violations Survey

On August 31, 2018, CSLB staff distributed a survey to the CALBO membership. The survey asked the members to identify the most common and significant "solar-related code violations" they have witnessed as well as the license classifications associated with the violations. The CSLB received responses to the survey from 44 CALBO members. Below is a table of the significant code violations identified by CALBO members who responded to the survey. The numbers in the table indicate the number of times a CALBO respondent associated a type of code violation with the license classification indicated (C-10 Electrical, C-46 Solar, or B-General contractors).

The table shows that C-10, C-46, and B-General contractors were associated with the various solar-related code violations shown 61 times, 76 times, and 17 times, respectively. In another 14 instances, the survey respondents either failed to identify a license class associated with the violation, or identified the incident as involving a home owner or owner-builder.

MOST SIGNIFICANT CODE VIOLATIONS	C-10 Electrical Contractor	C-46 Solar Contractor	B-General Contractor	Not Specified / Owner-Builder
Wiring / Electrical Problems				
Bonding (*jumper removal, electrical bonding of pipes, bonded neutrals on subpanels, bonding of systems, bonding incorrect or not in place*)	2	4		1
Disconnection (*means of disconnect, subpanel disconnect problems, disconnect not in sight of storage, disconnect missing, disconnect not raintight or leaning, missing DC connects*)	5	6	1	1
Wire management on roof or under panels (*size, sagging, rubbing, unsecured, crimping, not supported*)	5	5	3	1
Conduit (*unsecured, cables in conduit wrong, anchoring, flash standoff, PVC instead-of*)	2	5		
Grounding (*not grounded per code, ground clip installation, grounding of hardware/rails/panels*)	4	2	1	1
Load issues (*calculations, conductor size*)		2		

Subpanel/panel wiring and multi-wire circuits (*improperly installed or identified, improper wiring through panels, electrical panel or bus bar overload*)	4	4	2	
Electrical Devices or Metering Issues				
Energy Storage System Wiring (*incorrect, or incorrectly wiring as manual transfer switch, or to a standby generator, failure to island [SFGE Rule 21]*)	3	3		
Breakers (*retention, amperage rating / de-rating, size, height, 100 or 120% rules, backfeeding, CEC 690*)	4	7	2	1
Splicing and taps at metering, line side tap and service meter listing	2	2		
Conductors (*sizing, cable management*)	2	4	2	
Backfeed and overcurrent protection sizing, point of interconnection (*705.12(D)*), **strand crossing**	3	2	1	
Feeders (size, running)	2	2		
Construction / Installation Problems				
Installation of ESS unit on wall (*mounting)*		2		
Hardware (*Roof mount spacing, racking, rack / rail sizing, module / panel securing [loose or unsecured], mounting, fire set back violations, lag screw section, fitting size/attachment problems*)	8	6	1	1
Roof water proofing				1
Other Issues				
Signage/labeling (*incorrect, missing, decals, directories, unlisted devices, conduit labels*)	7	8	3	2
Plans, single line drawing (*failure to follow, not meeting, not installing according to, panel calculations, quantity of units*)	3	5		3
Physical workspace adequacy (*clearance, space to work, causing damage to equipment, location of installation*)	4	5	1	2
Connections/grid (*serving utility approval, connecting to unpermitted or unsuitable electrical services, connecting to undersized or isolated services without room for conductors, CTs, other equipment*)	1	2		
TOTALS	61	76	17	14

According to the chart above, a C-46 contractor license is associated with 49% of the reported incidents, a C-10 contractor license is associated with 39% of the incidents, a B contractor with 9% of the incidents, and the remaining 3% are an unknown license classification or an owner/builder. There is an unknown margin for error in the two charts above because many of the respondents indicated that many of the installers held both the C-10 and C-46 license but did not make this distinction when associating the license type with the violations they witnessed.

The CALBO survey also asked the members to identify examples of injuries or damage that occurred because of these installation practices. A total of 34 survey respondents left the injury section "blank" and 10 explicitly state that they had no injury information to report. Many of the respondents also did not report any damages that resulted from the solar-related code violations. The responses of those who did report damage associated with these violations are indicated in the chart below with the license classifications associated with the damage.

REPORTS OF DAMAGE	C-10 Electrical Contractor	C-46 Solar Contractor	B-General Contractor	Not Specified / Owner-Builder
Equipment Damage				
Wiring pinched between modules and racking	1			
Wiring drug across roof showing signs of damage to insulation	1			
Incorrect grade of bolts at column/girder connections resulted in panels collapsing onto vehicles in high wind*	1	1		
Equipment damage due to overloaded panels		1		
Equipment damage due to lack of proper grounding methods	1	1	1	
Inverter failure and arc flash nearly causing fire and destroying inverter**				1
Damage to roof coverings (concrete tile roof covering damage) or roof leaking				2
Fires				

Bad or old connections made in place of required utility splice connections resulting in fires				1
Fires at main service mains due to not cleaning busbar before back fed breaker installed; system energized prior to utility clearance	1	1	1	
TOTALS	**5**	**4**	**2**	**3**

*Respondent noted this system was installed according to approved engineered design
**Respondent noted that officials concluded that the failure of inverter's internal wiring was the cause

Finally, respondents to the CALBO survey were invited to make any additional comments. The following statements were drawn from the survey responses:

CALBO Survey Respondents – General Comments
[On the type of license associated with the size of system installed]
I have not noticed any correlation between system size and type of license installing them.
Our division issues owner-builder permits to systems below 20kw-AC
Most residential installs (with less than 40 panels) are C-10s with Bs the second largest group
Most panel installations under 5kw are [installed by] C-46s
Most hold C-10s regardless of system size
[On the overall workmanship of licensees]
Overall workmanship much better with C-10s [*a statement making this or a similar conclusion was made by three different respondents*]
Electrical work should be required to be performed by C-10s only *[a statement making this or a similar conclusion was made by four different respondents*]
C-46 contractors are the biggest violators [*a statement making this or a similar conclusion was made by two different respondents*]
Need to get the B contractors out of the solar installs
General Comments
If B licensed contractors are able to install a solar system, they should be able to install the integrated ESS, likewise for C-10 and C-46
Energy storage is such a young technology that there is no history yet. As inspectors we rely on the test lab to verify that the equipment is utility interactive based on UL [Underwriting Laboratories] standard 1741

A lot of these problems are due to salesmen not obtaining proper information at sale. Doing a plan review for projects in house rather than inspector field verifying information onsite and writing corrections that could've been caught at plan review

Other issues [involve battery] capacity, which [reflects] undersizing [problems]. A permit applicant submitted plans which showed a battery backup that is connected to the whole load of the house while its size is a fraction of the load. The Code doesn't address this issue.

As a plans examiner most of the items that I see that do not meet code are a direct result of the lack of information provided on the plans, product listing information, fire classifications of the installation, misinterpretation of fire access pathways, directory placards that are lacking detail.

Around 25% of the projects are not built per the permitted set of plans; the changes are found at final and in some cases cannot be approved as installed

Please know the licensee does not perform installs, instead an employee or laborer performs install

The PV industry is changing with materials, equipment and technology. Please consider the need to have all National Recognized Testing Laboratories [NRTL] (e.g. CSA, ETL, TUV, or UL) become more transparent with inspection and plan staff. I have found numerous occasions the report issued by an NRTL was more trade secret or proprietary, therefore making any investigation for a specific listing end with no information to learn. [This is a] disparity between NRTL and AHJ [authority having jurisdiction]

SECTION FIVE:

Summary of Letters from the Public

Introduction to Written Correspondence Received from the Public

On February 23, 2018, the Contractors State License Board (CSLB) placed the following item on its agenda for its February 23, 2018 Licensing Committee meeting: "Review, Discussion, and Possible Action on License Classifications Authorized to Install Energy Storage Systems." On April 17, 2018, the CSLB announced its intent to hold a public participation hearing to gather information on energy storage systems that will be used to review the appropriate classification(s) to install an energy storage system in a standalone contract or as part of the installation of a solar photovoltaic system. In the months before and after these announcements, CSLB received numerous letters from various members of the public on the topic of C-10 or C-46 contractors installing energy storage systems.

This section summarizes all 269 letters received from the public up to and those received on March 8, 2019: 121 letters were written on behalf of the C-46 Solar Contractor industry, and 148[3] were written on behalf of the C-10 Electrical Contractor industry. In addition to letters on behalf of the C-10 Electrical Contractor industry, CSLB received a press release, and a petition signed by 2,877 individuals on behalf of the C-10 Electrical Contractor industry.

To maintain objectivity and anonymity, this report does not identify letter writers; however, copies of all the letters are available upon request and will be redacted as necessary for confidentiality of non-public persons. The summaries of the letters in this section may not summarize all the information provided in every letter; the summaries are designed to address information not already repeated in another summary and to summarize facts not opinion or argument from the original letters.

[3] This total does not include the letter from the California Building Officials (CALBO) association. The CALBO letter is described on page 33 of this report, and thus not described / included in this section of the report. Therefore, the technical total of the letters received in support of the C-10 Electrical Contractor industry is 149, not 148.

Letters Written on Behalf of the C-46 Solar Contractor Industry

This section of the report summarizes the 121 letters written on behalf of the C-46 Solar Contractor industry. The CSLB received 121 letters from various authors on behalf of the C-46 Solar Contractor industry. The letters all oppose CSLB changing its existing license classifications. This section summarizes the letters into two tables: (1) Letters from Contractors; (2) Letters from Industry Representatives. Many of the letters are written from the following template:

> [Name] [Title] [License] [Years' Experience] [Number of Employees] I am writing to express my strong opposition to changes to the licensing classifications authorized to install solar and energy storage systems. The safety of my workers and my customers is of the utmost importance. To imply otherwise or to suggest that my staff is unable to install solar and energy storage systems safely is, simply put, inaccurate.
>
> As you know, the C-46 contractor can and has installed solar and energy storage systems for decades. In addition, the General A contractor has been able to install energy storage when specialized engineering is required, and the General B contractor has been able to do so in connection to a structure. There is no evidence that, for the sake of public health and safety or for any other legitimate public interest purpose, the installation of solar and energy storage needs to be restricted to the C-10 license only.
>
> The fact is energy storage has always been paired with solar photovoltaic systems, ever since the technology was first used in off-grid homes. The advent of net metering in the mid-1990s made grid-tied solar photovoltaic systems possible without batteries, but the pairing of these technologies nonetheless has never waned. That the C-46 license has been able to install energy storage is evidenced by the fact that the C-46 test has contained more questions on energy storage, and for many more years, than any other test administered by the CSLB.
>
> From a safety point of view, energy storage technologies are getting safer, simpler to install, and more plug-and-play. Batteries today are UL listed, with circuit breakers to prevent thermal events, and other safety features that are designed for easy installation and widespread use.
>
> It is important to note that energy storage is rapidly becoming a necessary part of the grid-tied solar market with the advent of Time-of-Use rates and the need to smooth out the intermittency of renewable energy. To cut off the C-46 contractor, or the A and the B, from installing energy storage would be to effectively cut those contractors off – contractors like myself – from the very market we've worked so hard to build.
>
> Thank you for considering these comments. I urge you to reject any proposals to restrict solar and energy storage installations.

The first table summarizes 73 letters representing solar installation companies. The individuals in this table identified themselves as a qualifier for a CSLB license or working in a high capacity (director, manager, officer) for an identified licensee. Many of

the letters were submitted using the template above, without providing additional information. Those letters are indicated below by the word “template” in the “comment” column. Other letters expanded upon the template with additional commentary or were entirely original letters. These letters received full summaries in the table below.

LETTERS FROM CONTRACTORS IN SUPPORT OF C-46 SOLAR CONTRACTORS INSTALLING ENERGY STORAGE SYSTEMS PAIRED WITH SOLAR PV				
#	Date	Author	Years in field / # of employees	Comments
1.	5/15/18	B	18 / 20	Perfect safety record. Staff is well trained, and we have put in place safety protocols that has kept us safe and our customers protected from any safety concerns.
2.	5/15/18	C-46	40 / 4	Template
3.	5/15/18	AZ contractor	35 employees	Hold NABCEP PV installation certificate and passed required safety standards to be an APS approved contractor in Solar Communities Program
4.	5/3/18	C-46	40 / 30	Template
5.	5/18/18	C-46 / C-10	12 / 6	We have not had a claim from an injured employee and have been installing solar with storage since opening our doors.
6.	5/15/18	B	11 / 25	Have performed countless jobs including LAUSD, SMMUSD, NMUSD solar projects making sure we uphold the OSHA requirements and standards for all projects
7.	5/10/18	C-46	40 years’ experience	Template
8.	5/25/18	B / C-10	40 / 8	Template
9.	5/4/18	B / C-46	35 / over 35	Template
10.	5/15/18	C-46 / C-10	8 / over 10	Template
11.	5/4/18	B	3 / 5	Change would put us out of business. Strong track record in install quality and safety. Adhere to every safety precaution and procedure. Intimately familiar with NEC code. Often use C-10s when need to. Often correct work of C-10s. Inaccurate to say C-46s cannot do this work. Experience with certified electricians and C-10s indicate they are not better placed to do solar.
12.	5/14/18	C-46	5 employees	Certified by NABCEP since 2009 and attend at least a dozen webinars and conferences each year to keep up to date on all advances in the solar industry including extensive battery storage system information.
13.	5/7/18	C-46 / C-36 / C-20	14 years’ experience	Been through several battery manufacturers’ training and have extensive experience with off-grid solar and battery integration. Make sure every installer has appropriate training to handle battery systems safely.
14.	5/16/18	C-46	34 / 160	Template
15.	4/25/18	B	13 / 20	Template
16.	5/15/18	C-46	35 / 60	Installed over 8,000 solar energy systems and serviced tens of thousands of others and never had a complaint or claim against insurance. All systems must comply with NEC,

				Section 690, which has been continuously re-written and updated over the years with input from the C-46 community.
17.	5/18/18	B / C-46 / C-36	44 / 40	Installed 25 systems and 40 in our pipeline. Unacceptable to revoke these opportunities from our team. Follow all safety protocols, fully capable and comfortable performing all installations having to do with energy storage
18.	5/3/18	C-10 / C-46	9 / 75	Template
19.	5/4/18	C-46	38 / 14	Template*
20.	5/4/18	C-46	38 / 14	Template*
21.	5/8/18	B / C-46	9 / 6	Template
22.	5/16/18	B*	14 / 30	Template
23.	5/16/18	C-46*	14 / 30	Template
24.	5/7/18	B / C-10 / C-46	9 / 12	Template
25.	5/15/18	C-46	40 / several	Template
26.	5/18/18	C-10 / A / C-46 / B / C-39	3,000 employees	Change is not necessary and would do more harm than good. NEM 2.0 and time of use rates are market forces driving solar and storage closer together. Solar and storage contractor (including C-46) must know NEC including but not limited to 690 (solar PV), 705 (interconnection), 250 (grounding and bonding), 110 (general requirements), Chapter 3 (wiring methods), 240 (overcurrent production), 706 (storage - NEC 2017). That NEC does not put solar and storage in one section does not mean they are not installed as a system nor does it preclude installing as a system. Energy storage products are now more closely resembling grid-tied products from voltage and amperage perspective. Voltages of 300-400 VDC in battery packs is similar to 300-600 VDC in grid-tied solar that C-46s are very familiar with. Currents in 20-amp range closely resemble wire sizes and types seen for grid-tied systems with #10 and #8 wires. Nothing new for C-46.
27.	5/18/18	C-46*	44 years	Improvements in battery design have made them safer and easier to install. Issues reported by CSLB Solar Task Force show issues exist for all license holders not just C-46.
28.	5/18/18	Solar Installer*	11 years with same company in letters #27 / 29	Solar installer with 11 years of experience for company. Training an experience allowed me to obtain by own C-10 license, and NABCEP license and OSHA 10Hr and 30Hr cards. C-46 is a multi-craft trade. While it encompasses electrical it is also broader than C-10.
29.	5/18/18	C-46*	44 years	Been doing this since 1974. Not aware of any evidence that would indicate for public health and safety any reason to restrict to C-10 license. Before 1996 net metering passed batteries were almost always paired with solar PV; net metering made separation more possible and more common but did not mature until 2001. Before 2001 when high voltage (600V) inverters became available almost all installations were low voltage battery-based systems. The safety issue at the time was higher voltage DC runs not energy storage (lower voltage). Therefore, C-46 license ability to install high voltage DC runs was proven in 2001.
30.	5/8/18	B / C-46	41 / 80	Never felt need to acquire C-10, never had problem getting permit. No reason to change requirements, will cause more harm than good. Grid-tied residential PV started in CA around 1998 with NEM (net-metering) and SGIP (solar generation incentive program) rebate program. At time, no grid-tied PV inverters would operate without batteries until around 2003. For 5 years all residential PV installers were building experience with battery storage plus PV. Incumbent on all license holders to train people to provide safe place to work. Only two solar-related fatalities in CA happened at C-10 companies. Lithium-ion batteries are far cleaner and safer to handle than lead-acid installed 20 years ago and will only get easier to install. There is not enough certified electricians to service this large and growing industry. Making this change will put tens of thousands of trained solar installers out of work.

31.	5/11/18	B*	33 / 45	This will lead to higher prices paid for no safety benefit at a time when the state is advocating for increased use of storage systems and reduced energy costs. Solar systems are routinely installed at 600 volts and many hundreds of amps. There are no elements of energy storage systems that pose threat to workers, consumers or residents that are of any greater threat than what is currently installed. Installing an ESS is no more complicated than installing a solar inverter. A typical ESS system with a concrete foundation requires several trades of which C-10 is only one. ESS is rapidly becoming necessary part of grid-tied solar market and is now required by many cities and counties. This will cause bankruptcies and lost jobs.
32.	4/8/18	B*	33 / 45	Template
33.	5/18/18	C-20 / B / C-10 / C-46*	Not stated	Solar and energy storage are multi-craft trades covering many disciplines. There is a broad array of energy storage technologies on the market, some mounted on individual solar panels and installed on a roof, carport or ground mount, others like an inverter in the garage, or mechanical room on side of building. Safer to install than the old lead acid batteries solar installers have been installing for decades.
34.	5/18/18	C-20 / B / C-10 / C-46*	Over 30 employees	Energy storage is rapidly becoming necessary part of grid-tied solar market. It will eventually not be possible for install solar without pairing it with energy storage. We invest significant time and resources in training and developing skilled workforce. C-46 contractors have installed solar paired energy storage systems since before CSLB had a specialty solar classification. Off-grid solar systems require ESS to function and the earliest grid-tied systems had ESS. Newer systems have more safety features than the old ones including monitoring systems.
35.	5/18/18	Solar installer for company #33 and 34 above*		Same letter as #33
36.	5/18/18	Solar installer for company #33 and 34 above*		Same letter as #33
37.	5/15/18	B / C-46	25 years' experience	Twenty-five years ago, all PV systems were battery based and the C-46 classification was limited to solar water heating. When CSLB shifted to solar PV, obtained C-46 and have not needed a C-10. Does not make sense to change now
38.	5/10/18	C-46	13 years' experience	Template
39.	5/16/18	C-46 / C-10	17 years' experience	Helped develop C-46 exam. Installed over 10,000 PV systems many with storage. Most of the testimony at CSLB's two-day hearing did not relate to what has become by far the most common type of battery storage system: pre-packaged UL listed systems with internal management components and integrated circuit breakers. Contractors making comments about the explosive or thermal runaway protentional of these integrated systems do not have experience with this equipment
40.	5/17/18	C-46	14 years' experience	Where is the problem that this purge claims to solve? Please stand up for the expertise, experience and rights of the C-46. Cutting them out is an insult to the builders of this market.
41.	5/18/18	C-46	42 / 20	I have updated the C-46 exam for CSLB for 10 years. The normal work of a C-10 Electrical Contractor involves alternating current (AC) which is why there are no battery storage direct current (DC) questions on their tests. The normal work of a C-46 is direct current and battery storage is part of the same training and language.
42.	5/22/18	B / C-10	30 years' experience	Solar PV requires the knowledge of many techniques and disciplines to install and retrofit into a structure. Many issues can arise in an install that dedicated electrical workers who are unfamiliar with the relationship, compatibility and fitness of the material and hardware involved may not be able to resolve
43.	5/17/18	C-46	Not specified	Storage systems have always been a part of PV more so during the early years. Many solar contractors train and attend workshops on the installation of battery systems. This requires working with the makers and suppliers of these systems.

44.	5/4/18	B / C-2 / C-46	35 years' experience	Installation of solar and energy storage is its own field, pioneered and driven by C-46. Prior to net metering C-46s were installing solar PV with lead-acid battery storage which was much more dangerous than lithium with the myriad of electronic safety features built into the charge controllers and inverters today. It is not clear what problem is trying to be solved. The need of ESS has been brought about by the electric utility time of use rate program. Limiting to C-10s will raise costs.
45.	5/15/18	B	35 / 250	Template
46.	5/14/18	B / C-46	34 / 15	Template
47.	5/16/18	C-20 / C-36**	34 / 2,500	Template
48.	5/3/18	C-46	8 / 30	Template
49.	5/15/18	B / C-46	38 / 40	Template
50.	5/18/18	C-46	7 / 10	Template
51.	5/3/18	C-46	10 / 2	Template
52.	5/14/18	C-46	12 years' experience	Template
53.	5/14/18	B, C-39	30 / 20	Exceptional safety record resulting in low insurance premiums. Training and awareness with our insurance provider.
54.	5/15/18	C-46 / B	24 / 25	Flawless safety record installing both storage and PV systems. Meet all OSHA safety standards on the job.
55.	5/14/18	B	8 / 500	Template
56.	5/14/18	C-46 / NM electrician	14 / 200	Multiple C-10 companies use our company and experience with batteries and storage technology as their battery expert. Variable DC voltages are more common in solar and battery systems than seen by C-10 electricians who do not do this work
57.	5/14/18	B / C-46	30 / 10	Template
58.	5/4/18	C-46	Not stated	Template
59.	5/17/18	B / C-10	60 / 80	We implement certified electrical, battery storage and safety training every day. There are many ways available for California contractors to obtain quality training. Though we are a C-10, discriminating against other related licenses will hurt California and industry. There are already many rules and regulations in place protecting the public, NEC, local agency inspections, etc. This area does not need another layer of regulation.
60.	5/16/18	A / C-10 / C-46 / B	10 / 40	Template
61.	5/18/18	C-46 / B	3 / 15	Template
62.	5/17/18	C-46 / C-10	Not stated	One of leading installers of solar in California, unique position to offer up opposition to the proposed licensing revision. Have installed over 100 MW of solar generated capacity and nearly a dozen proposed, designed, and installed ESS under C-46
63.	5/14/18	C-46*	18 / 20	NABCEP certified, steeped in NFPA, NEC, and OSHA protocols and standards. Staff attends regulator OSHA and NABCEP training and certifications from manufacturers. Storage has always been paired with solar PV when first used in off-grid when off-grid was the norm.
64.	5/15/18	C-46*	10 / 20	Mirrors letter #63
65.	Not dated	C-10 / B	9 / 15	Template

66.	5/11/18	C-46	19 / 20	Template
67.	5/15/18	C-46	35 / 6	Template
68.	5/15/16	C-46 / B	38 / 30	Template
69.	5/17/16	B / C-10 / C-46 / D-21	12 / 15	Template
70.	5/3/18	B	8 / 15	We have the knowledge and skills to build entire homes, far less properly install, attach, wire and commission an energy storage system. We all have specialized training and have 100% customer satisfaction rating.
71.	5/4/18	C-46	39 / 10	Template
72.	5/15/18	C-46 / C-10	Since 1978	Have installed thousands of battery systems. Manufacturer of lithium ion for 7 years, they are much safer than lead acid. Hearing testimony stated that Tesla and LG batteries are complicated, need extensive training and vulnerable to incorrect installation. This is not true. They are plug and play. You cannot get inside the battery compartment. If there is a problem, you ship it back. Both systems never put cells in a series above approximately 120 VDC. A converter is used to boost to 400. Battery systems have very simple rules and guidelines to observe and follow. The ESS on the market today are plug and play. They are AC coupled utility support systems that do not allow anyone inside the system and therefore cannot be installed "improperly."
73.	5/18/18	B / C-10 / C-46 / A	30 years	Manufacturer and installer of solar electric components and systems for residential, business, government, school, and utilities. Extensive experience installing paired solar and ESS. We go to great lengths to ensure our systems are installed by a trained workforce. We have worked with C-46s for many years in CA and find no lack of knowledge, skill, or training needed to properly install ESS paired with PV

*Different representatives with same company
**This company previously held a C-10 and C-46 but that qualifier recently disassociated. The company is under suspension for lack of qualifier as of March 6, 2019.

Not indicated in the table above are 27 additional letters signed by individuals identifying themselves as "solar installers" for the author of letter number 45 above. The 27 letters are from the same template, which reads as follows:

> My name is [Name], and I am a solar installer with [Company]. I have several years of experience in the industry. I am writing to express my strong opposition to changes to the licensing classifications authorized to install solar and energy storage systems.
>
> The safety of the customers I serve is of the utmost importance and my training and on-the-job experience reinforces that priority every day.
>
> It is also important to note that solar is a "multi-craft" trade entailing many different skills including site analysis, building structure suitability and reinforcements, roof penetrations and methods for walking on roofs to prevent damage, and many other skills. While the job encompasses electrical work, it is much broader.
>
> Finally, energy storage technologies are getting safer, simpler, and easier to install. Many battery systems are UL listed, with circuit breakers to prevent thermal events, and other safety features that are designed for plug-and-play installation and widespread use.
>
> Thank you for considering these comments. I urge you to reject any proposals to restrict solar and energy storage installations.

Finally, CSLB received an additional 21 letters from industry representatives of solar associations, battery distributors, manufacturers, and others on behalf of the C-46 Solar Contractor industry. The letters all oppose CSLB changing its existing license classifications. Many of the letters are drawn from the template indicated above and are summarized in the following chart in the same manner as the previous chart.

LETTERS FROM INDUSTRY REPRESENTATIVES IN SUPPORT C-46 CONTRACTORS INSTALLING ENERGY STORAGE SYSTEMS PAIRED WITH SOLAR PV

#	Date	Author	Comments
25.	5/18/18	Solar Distributor	Template
26.	5/16/18	Energy Storage Company	Santa Clara based energy storage company with focus on providing schools and public sector customers energy bill savings with smart energy storage technology, primarily lithium ion.
27.	5/18/18	Designer and Manufacturer	The C-46 was the original energy storage and solar installer in California. Company is leading designer and manufacture of advanced power electronics and energy storage for off-grid and gird-interactive solar plus storage applications. The C-46 can and has installed solar and energy storage systems for decades. There is no lack of knowledge, skill, or training needed to properly install our products.
28.	5/18/18	Designer and Manufacturer	Designs and manufactures energy storage, solar and electric vehicle charging systems highly integrated to one another requiring specific training by our staff for installation.
29.	5/16/18	Engineering Plan Set Services	Involved in PV training and codes/standards development and panel member for UL 2703 technical panel, and officer for NABCEP (national solar industry certification organization). The significant majority of solar and energy storage systems in California were installed by C-46 by the mid-2000s. C-10s have only shown interest in this technology recent years. There is no lack of skill training or knowledge in C-46.
30.	5/16/18	Manufacturer	Leading manufacturer of microinverters for PV and storage, installation base of over 16 million microinverters globally, plug and play solutions for residential and small commercial. Energy storage is rapidly becoming like any other appliance. Installer not exposed to terminals. In sales of over 10,000 storage units to date in dozens of countries have had zero reported cases of injury or property damage. We are simplifying designs, installation procedures, and safety procedures. Not aware of any significant incidents related to energy storage by C-46 contractors.
31.	5/17/18	Manufacturer	Successful California manufacturer of residential, commercial and mobile lithium ion energy storage systems. Have worked with both C-46 and C-10 contractors to install our systems safely and to code and standards. There is no evidence the installation of these systems needs to be restricted. We need to increase, not decrease, the number of qualified installers
32.	5/7/18	Nonprofit green policy advocate	The installation of solar energy systems has been determined to be a multi-craft occupation numerous times by the state of California. Energy storage has been a part of the solar photovoltaic installation and market for over 40 years. Emerging markets like solar and energy storage must remain accessible and inclusive for all workers.
33.	5/16/18	PV mounting structure manufacturer	Japanese subsidiary providing products of technical benefit translating to time savings on rooves. Solar contractors are dedicated and have the knowledge, and manufacturers provide training to installers and contractors.
34.	5/15/18	Roof attachment manufacturer	We go to great lengths to ensure our products are installed by a trained workforce. We have worked with hundreds of solar contractors throughout California to provide education, live, on-demand, in person, hands-on and jobsite training. C-46 contractors have installed solar and energy storage systems for decades. There is no lack of knowledge or skill or training to

			install our products.
35.	5/18/18	Technology company	Our home energy storage product is being deployed in residential applications through our direct installers and through our certified installers and resellers. To support the State's ambitious clean energy and energy storage goals, we should be increasing, not limiting the number of qualified installers.
36.	5/18/18	Engineer	Limiting the installation of solar and energy storage systems to C-10 license holders eliminates the substantial work force of qualified C-46 license holders which employers' numbers nearly equivalent to licensed electricians. In nearly 40 years at national laboratory, established the first PV test facility where inverters, controllers and complete systems were developed and evaluated. I have served on numerous panels for code development and UL standard committees. Founding member of NABCEP and served on IEEE standards groups. C-46 installers provide safe and code compliant installations and supply expertise and knowledge to this industry. I do not see a need to eliminate an established 50% of the qualified workers on solar systems.
37.	5/18/18	Inverter distributor	Subsidiary of international company providing single and three phase inverters to the US PV market for residential, agricultural and commercial PV solar systems. The next generation of inverters will feature energy storage options (high capacity lithium-based batteries) that easily integrate with inverters in a DC coupling manner. These hybrid solutions are a component of a hybrid or stand-alone PV system in the Code (690(1)(b)) and is not a separate system. There is no construction of a battery system just a connection of equipment using standard wiring practices already employed with non-battery systems. We have worked with C-46 contractors for years and find no lack of knowledge, skill, or training needed to properly install our products.
38.	5/14/18	Manufacturer and distributor	There is proven, mature, safe and well-functioning industry in California. This change will hurt the renewable energy industry. Battery energy storage manufacturer and distributor powered by safe lithium batteries throughout U.S. They require zero maintenance with numerous safety mechanisms built into the system to make installation safe and quick. We certify and vet all our dealers to install the product. Many of our installers have been installing for over a decade and complete our technical training.
39.	4/10/18*	Solar Industry Representative	CSLB should allow C-46 contractors to continue installing solar plus storage systems as they have done safely for years. A C-10 license is unnecessary to ensure safe installations and is inconsistent with national best practice. This decision exposes consumers to risk by disqualifying the storage portion of their system from investment tax credit. The purpose of a C-46 license is to allow contractors to perform electrical work in connection with a solar system installation. There is no evidence that limiting installations to C-10s improves safety; C-46s have installed solar plus storage safely for years and regulatory structures are in place to promote safe installations.
40.	5/16/18	Advanced Battery Developer	Developer of advanced battery technology since 1991 including lithium ion. Qualified solar installers have successfully installed, operated and maintained our energy storage products. Our home battery is simple and easy to install and is just a component within an installer's full residential solar installation
41.	5/17/18	Building Industry Representative	California Energy Commission updated energy efficiency standards will take effect January 2020 with first-of-its-kind solar mandate for new homes and apartments. CEC has approved significant compliance credit for voluntary installation of battery storage technology in combination with rooftop solar PV. There will be an increasing consumer demand. This decision will reduce available workforce. We are unaware of worker or public safety issue being document. These smaller scale systems are becoming easier to install. Manufacturers responding to market-demand are producing plug and play battery systems fully integrated with inverters. The C-46 has been installing these systems for years.
42.	5/18/18*	Solar Industry Representative	Requiring a C-10 license is unnecessary to ensure safe installation of solar plus storage systems which C-46 contractors have done for years. Multiple states outside of California offer solar-specific contractor or sub-contractor licenses including Nevada, Connecticut, Utah, and Florida. Each allow solar contractors to install solar plus storage. This is neither new nor unique to California.
43.	4/10/18*	Solar Industry Representative	If CSLB revokes C-46 ability to install storage-paired solar system, it may revoke the ability to install solar PV of any kind given trends in the marketplace. Solar PV systems contain many different parts that include but are not limited to PV modules made up of cells, racking and

		mounting hardware, inverter, energy storage (both AC and DC coupled – for many systems, battery and PV system share inverter). An ESS, when paired with a solar PV array, is a fully integrated component of that system, not a separate component. Warranties of existing systems installed by a C-46 could be voided by this decision. California Public Utilities Commission updated its 2017 SGIP guidebook citing CSLB authorization of C-46 licenses installing solar plus storage. Lithium-ion batteries are modular (scales up or down depending on consumer energy needs and DC circuits of one or two family PV systems can operate up to 600V, which C-46 are quite familiar. Manufacturers are now selling with UL 9450 compliant products which will soon be added to CA Fire Code and Residential Codes and is associated with pre-engineered, prepackaged systems that some will refer to as "plug and play."
44. 5/18/18*	Solar Industry Representative	Solar installations are a "multi-craft" trade. The on-the-job work entails many different skills. There is no significant difference between the voltages in a battery pack and the voltages in a grid-tied solar PV array. Any energy system with an inverter is a "system" in the NEC. The inverter connects the solar array with the storage device and is part of the solar PV system. The C-46 was given its current definition long after the practice of paring solar and energy storage. Over 700,000 solar PV systems have been installed in CA the last 15 years many with ESS. We are unaware of any accident or problem related to the installation of an ESS. There are approximately 30-40k solar installation workers in CA. If they are precluded from installing solar plus ESS there would not be enough workers in this growing market and may increase the installation costs of going solar.
45. 5/17/18	Fire Captain	28 years as firefighter and 13 years in house powered by panels and batteries off grid. Taught over 1,000 firefighters across the county how to respond to emergencies involving solar panels and battery storage. Solar panels and storage are one entity and have to be approached in that manner; there are deadly consequences if first responders don't shut the system down as one unit. Idea of separating the systems is impractical and can lead to confusion in an emergency. Not aware of worker or safety incidents caused by installation of solar and storage. Manufacturers are meeting market demands for pre-engineered plug and play systems integrated with inverters; makes installation safer and ability for firefighter to deenergize.

*Two individuals wrote the four different letters indicated on four different dates

Letters Written on Behalf of the C-10 Electrical Contractor Industry

The CSLB received 148 letters from various authors on behalf of the C-10 Electrical Contractor industry between February 2018 and present day. The letters all support limiting Energy Storage System (ESS) installation to C-10 contractors irrespective of their connection to solar PV system.

In addition to the 148 letters, on March 6, 2019, CSLB received a letter, press release, and petition signed by 2,877 individuals. The letter was on the template that is reproduced below and is the most common template used among the letters summarized in this section. The press release states that "safe installation of battery ESS by qualified electrical contractors and electricians is key to protecting public safety." The petition states that the "undersigned strongly urge the Contractors State License Board to uphold its commitment to protect consumers and the public by allowing only qualified C-10 Electrical Contractors to install and maintain battery energy storage systems." The petition was generated from https://safeenergystorage.com/, a website which allows visitors to sign the petition and to "tweet" CSLB staff. As of March 12, 2019, CSLB staff had received 120 "tweets" from various sources with the following message: "please clarify regulations to ensure battery energy storage systems are safely installed by only C-10 electrical contractors."

This section summarizes the 148 letters into 7 tables: (1) Letters from Trainers / Educators; (2) Letters from Workforce Unions; (3) Letters from Contractors; (4) Letters from Utilities; (5) Letters from Other [Interested Persons] (6) Letters from Elected Officials; (7) Letters from Law Firms. Many of the letters appear to be written from several different templates. As mentioned above, one template appeared to be used more frequently than others. The most common template submitted by letter writers is reproduced in its entirety below, as follows (emphases in original):

> Thank you for your continued efforts to protect California consumers by ensuring the construction industry adheres to policies that promote the health, safety and general welfare of the public. We are appreciative of the thorough review the Board has taken in recent months and are writing to **urge the Board to clarify current regulations to**

require that only specialty contractors holding a C-10 electrical contractors license may install battery energy storage systems.

The use of battery energy storage systems is rapidly expanding in hospitals, schools, businesses and homes throughout the state. This technology is key in helping California meet its clean energy and emissions reduction goals and to expand the adoption of solar, wind and other clean energy sources. However, if not installed and maintained correctly by highly-qualified and licensed C-10 electrical contractors, battery energy storage systems pose unique fire, electrical and public safety risks to installers, consumers, utility workers and emergency personnel. Ambiguity in the regulations has allowed C-46 solar contractor licensees to install battery energy storage systems when paired with a solar photovoltaic (PV) system, even though these battery energy storage systems are separate electrical systems and the C-46 solar contractors do not have the electrical training or expertise required.

A PV energy system is very different technology than a battery energy storage system. A battery **transforms** electrical energy to chemical energy and back into electricity. For that reason, CSLB regulations specifically require a C-10 license to "*install, erect or connect any electrical wires, fixtures, appliances, raceways, conduits, solar photovoltaic cells or any part thereof, which generate, **transmit**, transform or utilize electrical energy in any form or for any purpose*."

C-10 licensed electrical contractors have an extensive background in electrical theory and, by law, are required to install battery energy storage systems with highly trained electricians who have been certified by the state. In contrast, C-46 licensed solar contractors are not specifically qualified to safely install this complex technology and their installing employees have no training nor certification requirements.

We are urging the Board to not compromise safety standards by continuing to allow a C-46 solar contractor to install a battery energy storage system. CSLB regulations specifically prohibit C-46 solar contractors from installing standalone battery energy storage systems.

Please adhere to the mission of the CSLB and protect public safety and consumers by ensuring battery energy storage systems are installed by only contractors who hold a valid C-10 electrical contractors license.

Any time any of the 7 tables to follow us the word "template" in the "comment" column of the table, it means that the letter was submitted by the letter writer using the template above. Other letters were drawn from other templates that are not produced here, to constrain the length of this report. Rather, those templates are summarized when they first appear; thereafter, letters using those templates refer back to the letter writer that first used the template, with a comment similar to the following: "Same letter as letter number 6 in "Trainer/Educator" table above."

TABLE ONE: Summarizes 15 letters from individuals identifying themselves as electrical educators or trainers, as follows:

LETTERS FROM TRAINERS / EDUCATORS ON BEHALF OF LIMITING THE INSTALLATION OF ENERGY STORAGE SYSTEMS TO C-10 CONTRACTORS			
#	Date	Author	Comments
1.	5/15/18	Training Director	Safety is fundamental in educating apprentice electricians. Apprenticeship training is thousands of hours classroom and hands-on. Cal/OSHA 10 and 30 are not electrical safety classes. It is not sufficient to rely on them for ESS training. Training CEs receive is not comparable to C-46. The installation of ESS requires ability to assess and adapt to unpredictable field conditions.
2.	5/17/18	Training Director	CE apprentices receive OSHA safety training, NFPA 70E, electrical safety in the workplace and apply knowledge of the NEC throughout the five-year program and their career. DC is the foundation of all electrical theory on which CEs are trained, includes full gamut of solar PV systems such as inverters, DC and AC, semi-conductors, power sources, variable frequency drives, and thousands of hours of training.
3.	Not dated	Training director	The current policy of C-46 installing and maintaining ESS is based on older technology. Current systems are more advanced and allow for larger storage. CA requires employees of C-10 contractors who install or maintain electrical equipment must be CEs. OSHA 10 and 30 are general safety classes that apply to all tradespeople. Only CEs are trained in electrical safety installation. The NEC requires a "qualified person" to install and maintain an ESS. C-46s do not have the training that meets this definition and cannot identify hazards. ESS is separate system from PV subject to different codes and safety risks.
4.	Not dated	Instructor	ESS and solar PV are two separate systems with different risks, hazards, permitting and code requirements, and require different expertise. CEs are trained on DC and AC theory, grounding and bonding, NEC, ESS and microgrids, power quality, PV installation, load calculations for systems and instruments. Any worker required to install an ESS would be nothing less than a qualified electrical worker as defined by CA and Federal OSHA, NFPA 70E and NFPA 70B.
5.	Not dated	Training Director	C-46 should not be allowed to install ESS even when connected to PV. C-46 contractors are not qualified for this. Improperly installed ESS pose significant public safety risks if improperly installed. PV and ESS are separate systems with different risks that require more skill.
6.	5/17/18	Apprenticeship and Training Committee*	This is not a union issue. Thousands of C-10 contractors employ non-union CEs. To be a CE you have to pass a test union or not. Employees do installations, so it is the qualifications of the employees that matter. C-46s do not have employee requirements. C-10 employees must have at least 8,000 hours of electrical training and experience. CalOSHA 10 and 30 are general safety classes not sufficient on electrical safety. Plug and play does not mean simple and easy. UL listing means tested for safety but does not guarantee safety. They can still catch fire. ESS store large amount of electricity. PV will shock you, ESS will kill you.
7.	Not dated	Instructor**	C-46 should not be allowed to install ESS even when connected to PV. C-46 contractors are not qualified because they have no state requirements for electrical training and experience. Cal/OSHA general safety training is not electrical. PV and ESS are separate systems with different risks that require more skill. They can overheat, explode, catch fire, and electrocute at a greater level than PV. Fire Code provides for separate permitting, code and safety requirements for ESS. Battery storage permits have specific room design and fire suppression requirements.
8.	5/15/18	Training Director	CEs trained over 5 years, 8,000 hours job training 860 hours classroom, learn electrical theory and safety, NEC, OSHA, NFPA 70E. ESS is DC not AC. Need to understand electrical theory and safety codes to install and maintain. Arc flashes more serious with DC. Failure to understand this is life threatening.
9.	5/17/18	Training Director	A properly trained CE is aware of hazards inherent in any electrical installation and meets "qualified person" definition of NEC and CEC. 8,000 hours of on job training and 1,020 hours classroom training on electrical theory and safety, NEC, OSHA, NFPA 70E, blueprint reading, motor controls. ESS have become integral component in our industry so we are investing additional resources on training for them.

10.	Not dated	Assistant Training Director	Apprenticeships spend thousands of hours covering safety procedures during install and complete 1,020 hours classroom training on electrical theory and safety, NEC, OSHA, NFPA 70E, blueprint reading, motor controls. Recently added energy storage and microgrid training and certification. Battery and other ESS will always have inherent dangers in their construction and installation because there is no means of disconnect. The system does not remain at 12V or some other low voltage, potential increases as strings are connected.
11.	5/16/18	Training Director	CA requires employees of C-10 contractors who install and/or maintain electrical equipment to be state certified general electricians. The workers for C-46s have no iminium requirement for education, training, skills, and experience, which puts public safety at risk. Cal/OSHA training alone is inadequate because they are general safety not electrical. Lead acid batteries were smaller and less dangerous than modern ESS. NEC provides specific requirements for ESS operating over 50 or 60 volts, and car batteries are 12 volts and not subject to the standards. ESS and PV are separate systems with separate requirements and risks. Incorrect installation can start a fire. There is no such thing as plug and play.
12.	Not dated	Training Instructor	Apprenticeship training is thousands of hours classroom and hands-on. Cal/OSHA 10 and 30 are not electrical safety classes. It is not sufficient to rely on them for ESS training. Training CEs receive is not comparable to C-46. The installation of ESS requires ability to assess and adapt to unpredictable field conditions. ESS is becoming more technical and requires different set of skills. Early lead-acid batteries were smaller and less dangerous. Current battery chemistry and technology is different with different safety risks, requiring different knowledge, skills and experience.
13.	Not dated	Training Director	The installation of solar panels is under the C-46 licensing process. The installation of energy storage is not. The training requirements for training in energy storage are not covered under the licensing of C-46 contractors. When an ESS is not installed correctly, results are catastrophic.
14.	Not dated	Instructor	Reports no new information or otherwise substantially similar if not borrowing content from previous letters
15.	5/18/18	Electrical Instructor	The issue is not who the employer is, it is with proper training, knowledge and safe work practices. Storage batteries must be constantly maintained by monitoring fluid levels, toxic gas sensors and alarms, charge and discharge rate, ventilation systems and temperature sensing monitors. A solar panel can be plugged into itself with little to no damage but if you short a battery it will explode.

*This letter was signed by 11 individuals
**Representing same center as letter 5

TABLE TWO: Summarizes 18 letters CSLB received from on behalf of labor, contractor and/or workforce unions, or lobbying groups, as follows:

LETTERS FROM WORKFORCE UNIONS ON BEHALF OF LIMITING THE INSTALLATION OF ENERGY STORAGE SYSTEMS TO C-10 CONTRACTORS			
#	Date	Author	Comments
1.	2/22/18	Utility Employees Representative	PV systems and ESS connected to utility distribution systems is increasing but the race to install them should not be at expense of safety. ESS may be paired with PV but they are separate systems with different installation, permitting and code standards, and fire and safety risks and are located on different areas of property. ESS vary widely in size and type and can exceed 10MW at utility-scale.
2.	2/2/18	Electrical Contractors Representative	C-46 contractors are not licensed to install ESS as standalone projects. Many building officials do not allow C-46 contractors to install ESS because they are separate systems with unique fire and life safety risks with their own safety standards and code requirements. Improper installation could cause serious public safety hazards including explosion, electrocution, arc flash, arc blast, fires caused by shorting or thermal runaway. Only CEs who are qualified to install in these as standalone systems should be able to install at all. There are many different types of ESS some exceeding several MW. ESS is independent source of stored energy that can be paired with any energy source not just PV and predate

			PV.
3.	5/18/18	Electrical Workers Representative	C-46 are not qualified to install ESS and should not be authorized to install ESS whether they are connected to PV or not.
4.	5/18/18	Electrical Workers Representative	This is a training and safety issue. OSHA 10 and OSHA 30 are not adequate training courses. They reference electrical safety but are not electrical safety classes. NFPA 70E is an electrical safety class and is better for installing ESS.
5.	2/5/19	Electrical Contractor Representative	Template
6.	2/5/19	Electrical Contractor Representative	Template
7.	2/20/19	Multi-Trade Contractor Representative	Template
8.	2/21/19	Electrical Workers Representative	Template
9.	2/21/19	Multi-Trade Contractor Representative	Template
10.	2/20/19	Utility Employees Representative	Template
11.	5/16/18	Fire Fighter Representative	Solar PV and ESS are separate systems with different installation, permitting and code standards, and fire and safety risks. Battery cells in banks can operate at hazardous voltages and deliver severe electrical shock. Must be isolated electrically while any work is being performed on them or other parts of the ESS. Short circuit or fault can cause arc flash over 12k degrees. Higher storage capacity higher risk. Lithium ion prone to thermal runaway. Ruptured battery casing from over charging or short circuit can release toxic fumes and cause explosions. Applies to large commercial and small UL listed ESS. UL certification does not eliminate risk. Circuit breakers are not perfect. If wiring or distance from breaker is wrong, fire can start at broken circuit. Fire Code ESS requirements different than for PV for good reason.
12.	Not dated	Electrical Workers Representative	ESS is electrical storage. Electrical storage is electrical work. Electrical work is performed by C-10 electrical contractors not any other license. If another contractor can install ESS this will lead to accidents, injuries, fire, and damage.
13.	5/17/18	Electrical Workers Representative	Same letter as letter number 6 in “Trainer/Educator” table above.
14.	5/17/18	Electrical Workers Representative	Same letter as letter number 6 in “Trainer/Educator” table above. This letter is signed by 92 separate wet ink signatures.
15.	5/16/18	Electrical Contractor Representative	OSHA 10 and OSHA 30 are general safety training classes that include a certification if passed. They encompass all trades and reference electrical safety but are not electrical safety and do not substitute to NEC, Fire Code requirements. The discussion at the hearings of plug and play systems do not contemplate several megawatt microgrid ESS. C-10 contractors with CEs perform the preponderance of all electrical work in the state. Solar PV and ESS are separate systems with different risks, code and permit requirements, and different expertise.

16.	5/18/18	Electrical Workers Representative	Same letter as letter number 6 in "Trainer/Educator" table above.
17.	5/18/18	Electrical Industry Representative	Electricians comprise more than three-quarters of all construction workers. The market demand for skilled and certified electricians is growing faster than other construction occupations. UC Berkeley research shows lower pay and less training and fewer advancement opportunities in solar industry. There is no apprenticeship program for solar installers. Allowing C-46s to deploy undertrained under skilled and unrepaid workforce will affect the labor market and endanger workers and owners and stifle demand for electricians.
18.	5/18/18	Electrical Industry Representative	While C-46 contractors are clearly qualified and authorized to install solar PV systems, only C-10 contractors have the comprehensive electrical theory background and certified electrician workforce necessary to safely install modern ESS. Battery ESS is no longer low-voltage lead-acid car battery systems. ESS today are often utility-sized lithium battery arrays with MW of storage. ESS are independent electrical systems that pose unique risks and are subject to separate codes and safety and installation standards. The legislature created a certified electrician program for complex electrical work. The C-46 is limited on its face to solar PV and should not be extended to complex electrical work. The scope of work for C-46 cannot be expanded by exam questions.

TABLE THREE: Summarizes 36 letters CSLB received from contractors. The individuals in this table identified themselves as either a qualifier for a CSLB license or working in a high capacity (director, manager, officer) for an identified licensee.

LETTERS FROM CONTRACTORS ON BEHALF OF LIMITING THE INSTALLATION OF ENERGY STORAGE SYSTEMS TO C-10 CONTRACTORS			
#	Date	Author	Comments
1.	5/16/18	C-10 / B / C-7	Over 40 years' experience as electrician, designer, manager and partner. The codes and standards governing ESS are far reaching due to the complexity of the subject. Installers should be familiar with all codes and standards including NEC, CEC, NFPA, city specific adoptions, and any utility company rules relating to ESS
2.	5/17/18	B / C-10 / A / C-31	Same letter as letter number 6 in "Trainer/Educator" table above.
3.	5/18/18*	B / C-10 / A / C-31	Installing ESS of any size is a separate and distinctly more dangerous process than PV. More complicated requiring more skill and knowledge than PV. Low voltage installs are much less complex and less dangerous that is why there is a C-10 and a C-7. ESS vary widely in size, type and power requiring broader electrical knowledge and safety, ability to assess and adapt to unpredictable conditions. PV install is more predictable than ESS install. Improperly installed ESS is risk to utility infrastructure and workers. Different and separate systems with different code requirements, risks and dangers.
4.	Not dated*	B / C-10 / A / C-31	There are small residential units that are plug and play but there is an electrical tie in for those units and will have to enter live panel for interconnection. Anyone working on electrical panel should be trained for that install. Nothing is in place for ensuring this for C-46 workers.
5.	5/17/18*	B / C-10 / A / C-31	There is industry standard personal protective equipment necessary to hook up and service modern battery ESS. There are challenges inherent in these systems. Cal/OSHA training is insufficient to prepare C-46 for installing ESS. A 7kw system produces 7,000 watts. If no consumptive load and 8 hours sunlight, the battery will store 56,000 watts. This is not comparable to PV system. In the past lead acid was commonly paired with PV before grid-tied made them obsolete but now most systems are not paired with battery.
6.	Not dated*	B / C-10 / A / C-31	ESS can be complex and require knowledge and skill of trained person for their installation. Even plug and play units are suspect to safety issues if improperly installed. Just as a 15-100KW PV residential or commercial PV system is relatively simple comparted to a 1MW PV system at a waste treatment plant, the same is true with ESS. Some systems can be simple but C-46 should not have

			the ability to participate in larger complex systems out of their class.
7.	2/6/19*	B / C-10 / A / C-31	Template
8.	5/23/19*	B / C-10 / A / C-31	ESS is becoming more technical and requires different set of skills. Early lead-acid batteries were smaller and less dangerous. Current battery chemistry and technology is different with different safety risks, requiring different knowledge, skills and experience. NFPA is adopting new codes and standards particularly for ESS. Cal/OSHA general safety training is insufficient. Improperly installed ESS is risk to utility infrastructure and workers.
9.	5/17/19	C-10 / C-46 / B / C-7	ESS includes electrochemical, thermal, pumped hydro and machinal. Commercial and industrial system sizes range from 30kw to 5MW and employ lithium ion chemistries operating between 800-1,000VDC exceeding 100,000 amps at voltages ranging from 480 to kV and often require service upgrades, line side taps or new switch boards. AT 12kV medium voltage you are exceeding C-46 qualification, certification and safety. ESS safety concerns are arc flash, device coordination, improper conductor termination, improper crimps, DC voltage and amps interrupting rating, improper grounding. C-46 technicians do not have the training to work on these systems; the lead acid batteries were 12, 24 or 48VDC.
10.	5/15/18	C-10 / C-46 / C-39 / C-20	There are several different types and brands of ESS available for residential. Some are AC coupled others are DC coupled. Rapidly evolving and manufacturers constantly changing their products. They are not inherently safe. Installation techniques need to be followed. Size and power capacity of an ESS is limited only by the service it is connected to. Multiple ESS can be connected to the same service allowing for larger ESS (20kw plus) to power homes. This often requires main service panel upgrade which requires a CE otherwise there are risks.
11.	5/16/18	C-10 / B / C-7	Same letter as letter number 3 in this table.
12.	5/16/18*	C-10 / B / C-7	Shortened version of letter 11 in this table.
13.	5/16/18*	C-10 / B / C-7	Same letter as letter number 3 in this table.
14.	Not dated*	C-10 / B / C-7	Our alternative energy group does PV with ESS including fuel cells, hydro generation and battery storage. The different systems require different levels of knowledge and capability necessary to install correctly and safely. Battery storage projects are much more complex than PV systems and provide functions far beyond back up of the utility distribution system. Can include high voltage cables, inverters and up to 1,000 volts of direct current. Power stored operates as its own grid furnished power. NEC recognizes these are different systems. Banks of batteries operating at high levels of voltage and potential are capable of deadly electric shock and burn. There are serious risks from improper install. Batteries connected in series pose great danger to unqualified personnel but single batteries that are mishandled are capable of explosion and burn on their own.
15.	5/14/18*	C-10 / B / C-7	Same letter as letter number 3 in this table.
16.	5/14/18*	C-10 / B / C-7	Same letter as letter number 3 in this table.
17.	Not dated	C-10	Same letter as letter number 7 in “Trainer/Educator” table above
18.	5/16/18	C-10 / B / A	Have supervised electrical installation of roughly 400 MW of PV installs and can ensure the board that hazards associated with ESS are numerous and extreme. Even small battery storage units are capable of producing Arc Faults and shock hazards many magnitudes as powerful and damaging as a small residential PV. Understanding hazards and safely addressing them takes extensive training and special gear. Batteries on market require understanding charging and discharging characteristics. NEC states that it is not an instruction manual for untrained persons. C-46 contractors are untrained.
19.	5/18/18	C-10 / C-7 / A	Battery storage is not integral to a renewable energy project. Each comes with its own skill necessary for safe and efficient installation and pose different challenges, risks, and dangers. ESS can be an add on rather than a necessary part. Battery ESS has been installed in many other

			electrical systems with no renewable component for decades. They are constantly evolving and are different from what was installed years ago. Electrical expertise is needed to manage the wattage difference between a PV array and storage system.
20.	5/18/18*	C-10 / C-7 / A	Same letter as letter number 19 in this table.
21.	5/18/18*	C-10 / C-7 / A	Same letter as letter number 19 in this table.
22.	5/18/18*	C-10 / C-7 / A	Same letter as letter number 9 in this table. In addition, there are dangers and risks presented by modern residential ESS. They are smaller but represent dangers when installed by persons not defined as qualified by NEC. C-46 is not equipped to install residential ESS.
23.	Not dated	C-10 / A	Letter is the written testimony given by the letter writer at the public participation hearing, speaker # 57, day 2, with the additional comment that the plug and play systems described at the hearing as simple did not mention the risk of arc flash at the panel if improperly wired by the contractor nor did it mention large scale utility ESS which are not plug and play.
24.	5/15/18	C-10 / B	Time as a building inspector encountered C-46 contractors who did not have sufficient training or access to information and their employees were not familiar with the NEC. The qualified person is defined in the NEC and NFPA. The C-46 does not employ qualified persons. PV and ESS are separate systems and ESS is more complex and more dangerous. Residential solar install must conform to NEC but an ESS install must conform to NEC and also NFPA.
25.	5/17/18	C-10 / A	Modern ESS can produce over 10MW of power at commercial, residential and utility level. Incorrectly installed there is serious risk to installer, property and general public. The cost of C-46 using low or unskilled workers at low pay with few benefits impacts the public. ESS and solar PV are separate systems.
26.	5/22/18	C-10	ESS is constantly evolving from battery ricks filled with lead and acid to residential applications like Tesla. Once energy is stored the potential for release of all that energy in seconds if certain safety precautions are not used by knowledgeable trained people. Lithium ion has risk of thermal runaway unlike lead acid. C-46 workers may be able to install PV but that does not extend to their workers. ESS and PV are separate systems.
27.	Not dated	C-10	Installation of ESS and connections to electrical distribution system require understanding entire electrical system. ESS can produce as much as 10 MW of power and potential danger to installers, maintenance workers and public. C-46 workers have littler or no technical training which is a public safety risk when installing systems producing large amounts of electrical energy.
28.	Not dated*	C-10	Same letter as letter number 27 in this table, plus: there is an inherent dangerous nature to ESS systems and training is required to install every component, connection point, and safety label correctly to protect everyone in contact or utilizing the ESS.
29.	5/16/18	C-10	ESS installations present a much more complicated and hazardous environment and should be left to expertise of C-10s. ESS vary widely in type, size and power and require more skill and knowledge than PV. Improperly installed systems are a risk to workers, emergency responders and public and to the utility infrastructure when connected to grid. PV and ESS are different and separate systems.
30.	No date	C-10	C-46 may be able to install solar but do not have electrical skills and experience to install dangerous electrical systems because they are not required to have certified electricians. ESS systems are dangerous, they can catch fire and explode.
31.	5/17/18*	C-10	Same letter as letter number 6 in “Trainer/Educator” table above.
32.	5/16/18	C-10 / B	Battery ESS market is changing and expanding. Applying existing rules to this new market is potentially dangerous. Its growth is outpacing groups working to develop safety standards. More stringent requirements will be out in 2020. The systems in the new market are not the systems paired with smaller PV systems but are much more complex, requiring expanded knowledge of installation means and methods for varied electrical components.
33.	Not dated	Unable to identify	Bay area general contractor. Anything over 12V we also use C-10. If ESS are deployed without highest regard for public safety, it will disrupt the adoption of the technology. They could explode if less than rigorous installation standards are involved. They are separate systems with unique

			installation requirements. The intensity of the risk is greater than posed by solar PV.
34.	3/4/19	C-7 / C-10 / B / C-46	Template
35.	5/18/18	C-10	Solar PV with ESS on a home is a mini power plant and should be treated as such, being installed by electricians. These are separate systems with different risks, requiring different permitting and code requirements. Cal/OSHA training is inadequate to prepare and protect C-46 installation employees and the problem. C-46 contractors can and do hire workers with littler or no training which puts workers and end consumers at risk.
36.	5/16/18	C-10 / B / A	Reports no new information or otherwise substantially similar if not borrowing content from previous letters

*different individual with the same company as the letter immediately above

TABLE FOUR: Summarizes 4 letters CSLB received from persons writing on behalf of identified utilities, as follows.

LETTERS FROM UTILITIES ON BEHALF OF LIMITING THE INSTALLATION OF ENERGY STORAGE SYSTEMS TO C-10 CONTRACTORS			
#	Date	Author	Comments
1.	2/28/19	Utility Company	ESS pose unique and potentially hazardous safety risks if not properly installed or operated. The relatively new ESS technology is maturing and installations in residential and commercial settings should require a skilled, highly-trained workforce to ensure safety.
2.	2/20/18*	Utility Company	Same letter as letter number 1 in this table.
3.	2/20/18	Energy Utility	A solar PV system generates and exports energy while an ESS has two functions: charge and discharge. They vary widely and include mechanical, thermal, and chemical storage and can include the use of flywheels, ultracapacitors, superconducting magnetic ESS, molten salt, synthetic oil or compressed air. Commercial systems can go up to 20 MW. They have their own separate installation and safety standards. CA law is requiring more storage and these systems require special care. They need to be treated as separate from PV.
4.	2/20/18	Utility Company	ESS are a distinct specialty area. While C-46 are licensed to install, modify, maintain or repair thermal and PV solar energy systems, this does not translate to expertise for ESS, which requires adhering to specialized safety standards. Improperly installed ESS creates a serious risk of electrocution and fire. Specialized installers expert in safety codes and standards mitigates that risk. The amount of ESS on the grid will grow in coming years. To ensure reliable utility operation, ESS must be properly installed by skilled contractors. ESS is not required for PV system and therefore a C-10 or an A are properly licensed not a C-46.

*different or same individual with the same company as the letter immediately above

TABLE FIVE: Summarizes 65 letters CSLB received from various other interested parties identifying themselves as citizens, certified electricians, firefighters, inspectors, or other groups.

Table 5 begins on the next page.

LETTERS FROM OTHERS [INTERESTED PERSONS] ON BEHALF OF LIMITING THE INSTALLATION OF ENERGY STORAGE SYSTEMS TO C-10 CONTRACTORS			
#	Date	Author	Comments
1.	5/16/18	CE	The C-10 test has less questions on energy storage than the C-46 because the C-10 test has to cover a wide range of subjects. Not just DC, ESS devices and the tying in. C-10s deal with AC, DC, transformers, capacitors, fire alarm, communications, fiber, it goes on.
2.	2/20/18+	Fire Fighter	ESS are PV are separate systems subject to separate codes and permitting requirements and different fire and safety risks. Lead-acid batteries need adequate ventilation to avoid explosion. Lithium ion is prone to thermal runaway. ESS are serious safety risk for occupants and installers if incorrectly installed and operated. Large ESS may need engineered fire suppression systems depending on technology and configuration use. Building standard codes are constantly playing a game of catch up to ESS evolving technology.
3.	5/16/18	Building Inspector	ESS is relatively new and presents hazards and risks more serious and different than PV. The early lead acid systems were smaller and less dangerous than modern systems. Battery chemistry and technology, safety risks, knowledge, skills and experience required are all now much different.
4.	Not dated	CE	The written testimony of speaker number 1 on day 1 of the public participation hearing, submitted as a letter.
5.	5/18/18	"Energy Industry" Representative	Same letter as letter number 6 in "Trainer/Educator" table above.
6.	5/17/18	Electrical Inspector	Same letter as number 3 in this table.
7.	Not dated	Community Energy Workgroup Member	C-46s do not have necessarily electrical safety training to install ESS because they are not trained in NFPA 70E which covers the hazards. ESS is not plug and play and there are many kinds such as ultracapacitors, flow batteries, fuel cells, hydrogeneration, lead acid, etc. that require special training. ESS is becoming more grid connected
8.	5/17/18	Firefighter	Same letter as letter as number 11 in the "Letters from Workforce Unions" table above.
9.	5/17/18	Fire Captain	Template
10.	Not dated	Private citizen	Same letter as letter number 30 in the "Letters from Contractors" table above.
11.	Not dated	Private citizen	Same letter as letter number 30 in the "Letters from Contractors" table above.
12.	5/18/18	Private citizen	Same letter as letter number 30 in the "Letters from Contractors" table above
13.	5/17/18	Electrical Inspector	Tesla powerwalls are self-contained battery system with built in inverter. Only connection is a 30 am circuit and low voltage cable; you never see the batteries. A PV system and powerwall both supply AC from an inverter output to the building wiring but their functions are separate. Tying a solar install into building wiring often means only installing a back-fed breaker into a panel to accept the inverter output. But a complete powerwall installation requires a grid-isolating contactor panel installed either as a service disconnect or in a feeder, often to a new critical load panel. It may mean relocating a full panel of branch circuits and reconfiguring and reworking panel feeders and often requires installing at least one additional panel. The common theme for my solar inspections is the general lack of installer experience and being easily tripped up by relatively minor situations. C-46 licensees should get a C-10
14.	5/17/18	Private Citizen	Same letter as letter number 30 in the "Letters from Contractors" table above.

15.	Not dated	CE	Solar PV and ESS are separate systems with separate risks, codes, fire safety standards. Battery cells operating at hazardous voltages must be electrically isolated when work is performed on them. While some lithium-ion batteries have features to prevent uncontrolled rupture, technologies vary. All aspects of ESS should be installed by qualified electricians.
16.	5/18/18	Private Citizen	Same letter as letter number 30 in the "Letters from Contractors" table above.
17.	Not dated	Private citizen	Same letter as letter number 30 in the "Letters from Contractors" table above.
18.	5/17/18	CE	The complexity and interconnectivity of electrical systems need to be understand, such as consequences of hysteresis caused by the pulse width modulator, voltage drops, or ampacity de-rating due to temperature adjustments or conductors in a raceway, all of which can cause fire if not considered. These complexities are causing a push to create a new NFPA that will provide guidance for batteries and may be out in 2019. Understanding the NEC mitigates these dangers. (*Letter provides extensive detail on the technical aspects of training received by apprentices*)
19.	5/17/18	CE	The installation of ESS requires ability to assess and adapt to unpredictable field conditions. ESS is becoming more technical and requires different set of skills. Early lead-acid batteries were smaller and less dangerous. Current battery chemistry and technology is different with different safety risks, requiring different knowledge, skills and experience. The NEC requires a "qualified person" to install and maintain an ESS. C-46s do not have the training that meets this definition and cannot identify hazards. ESS is separate system from PV subject to different codes and safety risks
20.	Not dated	CE	UL listed just means tested for safety but not a guarantee of safety. UL listed devices do catch fire and circuit breakers reduce fire risk but do not eliminate it. Breakers can be overloaded or too far from the load or wire sizes can be wrong. ESS units are dangerous when installed incorrectly.
21.	5/18/18	CE	PV and solar are separate systems and treated separately in NEC and NFPA.
22.	5/16/18	CE	Same letter as letter number 19 in the "Letters from Contractors" table above.
23.	5/17/18	CE	Reports no new information or otherwise substantially similar if not borrowing content from previous letters
24.	Not dated	CE	Reports no new information or otherwise substantially similar if not borrowing content from previous letters
25.	Not dated	CE (7 citizens signed with author)	NFPA has conducted hazard assessments on batteries. Due to lack of knowledge and understanding related to the enabling technology, the installation and maintenance of ESS needs a perquisite list for anyone considering the task. Requires an understanding of science behind the system. In a report issued by Fire Protection Research Foundation covering lithium-ion battery hazards, it provides many ways battery failure can happen. A 2016 report by the foundation found that there were several gaps in the electrical, fire, and building codes related to ESS. NFPA is currently pushing for a new edition on ESS to be published in 2019.
26.	5/15/18	CE	Reports no new information or otherwise substantially similar if not borrowing content from previous letters
27.	Not dated	CE	Reports no new information or otherwise substantially similar if not borrowing content from previous letters
28.	Not dated	CE	When installing an ESS you are going from AC to DC. Many people are not aware that AC has less potential to hurt you than DC. Extensive electrical and safety knowledge is needed to install an ESS and it is not the same as a car battery.
29.	Not dated	CE	Some ESS use something other than batteries to store energy, such as compressed air or steam. The majority of ESS systems most C-46 contractors install are for housing and light commercial. These ESS systems are designed to be simplistic and safer compared to larger systems. ESS is more dangerous than panels; panels do not produce choking, poisonous or

			explosive gassing or explosion hazards. ESS can be drained of energy and recharge to dangerous potentials if not made safe. Because of internal differences between batteries and panels, accidental arcing of the output of a battery bank of the same voltage as a solar array can create a more powerful arc. ESS has been the least advanced portion of the electrical industry until the recent past.
30.	Not dated	CE	Anything related to electricity can kill any electrician if they are not trained and know the NEC.
31.	5/16/18	CE	It is one thing to be in the field of working on solar but another to contain and harness the massive power that solar systems create. Persons working on ESS must have the pertinent electrical knowledge and training to work safely around massive power. PV and ESS are dissimilar in many ways.
32.	Not dated	Independent consultant	Many contractors in the residential and small commercial segment of the solar PV industry fail to invest in comprehensive occupational training of their workforce. Ensuring the rapidly growing ESS sector be anchored on a trained workforce can be done by employing certified labor.
33.	5/16/18	Firefighter	Same letter as letter number 11 in the "Letters from Workforce Unions" table above.
34.	5/20/18	Electrical Inspector	Safe electrical installations depend on a team of designers, manufacturers, contractors, electrical workers, and inspectors. No one group can ensure a safe installation. All are needed.
35.	5/17/18	CE	Reports no new information or otherwise substantially similar if not borrowing content from previous letters
36.	5/17/18	Private citizen	Same letter as letter number 30 in the "Letters from Contractors" table above.
37.	Not dated	Private citizen	Same letter as letter number 30 in the "Letters from Contractors" table above.
38.	Not dated	Energy Manager for contractor	The variety of ESS requires more knowledge of the electrical portion and safety issues; variables include additional hazards, ability to identify problems and have experience to fix them. Solar PV is simplistic compared to ESS installation and maintenance.
39.	5/18/18	CE	Reports no new information or otherwise substantially similar if not borrowing content from previous letters
40.	5/17/18	CE	Reports no new information or otherwise substantially similar if not borrowing content from previous letters
41.	5/15/18	CE	The difference between a solar panel and a battery is potential incident energy. Shorting out a solar panel [*sic*] the available fault current is limited by the wattage of the panel. It is the difference of a few amps or 10s of thousands of amps. Panels also don't have cascading thermal breakdown like batteries.
42.	Not dated	CE	Reports no new information or otherwise substantially similar if not borrowing content from previous letters
43.	Not dated	CE	The written testimony of speaker number 36 on day 1 of the public participation hearing, submitted as a letter.
44.	5/14/18	CE	Reports no new information or otherwise substantially similar if not borrowing content from previous letters
45.	Not dated	CE	Same letter (different author) as letter number 42 above.
46.	5/17/18	CE	Same letter (different author) as letter number 42 above.
47.	Not dated	CE	Reports no new information or otherwise substantially similar if not borrowing content from previous letters

48.	5/17/18	CE	Reports no new information or otherwise substantially similar if not borrowing content from previous letters
49.	Not dated	CE	Same letter (different author) as letter number 42 above.
50.	5/17/18	CE	Reports no new information or otherwise substantially similar if not borrowing content from previous letters
51.	Not dated	CE	The written testimony of speaker number 12 on day 1 of the public participation hearing, submitted as a letter
52.	Not dated	CE and Apprentice Instructor	A technology as new as ESS should be investigated carefully. The components are constantly changing and we are far from the point where anyone can do it.
53.	Not dated	CE	Same letter (different author) as letter number 42 above.
54.	Not dated	CE	Same letter (different author) as letter number 42 above.
55.	Not dated	CE	Same letter (different author) as letter number 42 above.
56.	Not dated	CE	The written testimony of speaker number 18 on day 1 of the public participation hearing, submitted as a letter
57.	Not dated	CE	Same letter (different author) as letter number 42 above.
58.	Not dated	CE	Reports no new information or otherwise substantially similar if not borrowing content from previous letters
59.	5/16/18	CE	The written testimony of speaker number 45 on day 1 of the public participation hearing, submitted as a letter.
60.	Not dated	CE	The available short circuit current on PV systems is inherently limited. That is not the case with associated or stand-alone ESS. The need for utility scale energy storage is in its infancy and putting safety first now will prevent a misstep with tragic consequences in the future.
61.	5/17/18	Electrical Inspector	Same letter as number 19 in this table.
62.	Not dated	Developer / Builder	Anything we can do as an industry to raise the skill, knowledge and safety of those who install these systems is paramount. A lack of training and poverty wages does serious damage to the housing industry. ESS and PV are separate systems subject to separate requirements.
63.	Not dated	Energy Firm	Specializes in development and integration of boutique energy projects. Firm distributed survey to C-10 contractors inquiring about their background and experience in PV systems. 33 contractors reported. DC battery ESS installed = 1.6 million KW, average years installing = 31, number of DC PV residential and commercial installs: appx 171k. Power generated = 791.4 MW; utility scale installs: 205; utility power generated = 8.7 MW; avg number of years contractors have been installing PV = 13.7.
64.	1/31/19	Grassroots Environmental Organization	Strongly supported SB 100 to move CA toward clean energy economy by 2045. Battery ESS will be critical element of this and to succeed requires having qualified people install and maintain battery ESS.
65.	Not dated	Nonprofit Electrical Safety Group	ESS are fundamentally different systems from solar PV and subject to distinct code and safety requirements. Stored energy wants to escape and thus poses significant electrocution, fire, explosion, and thermal runaway concerns. This is a customer and worker safety issue. While battery ESS require connection to an energy source, it does not matter if this energy comes from the grid, windmill or solar PV array. If a contractor is not qualified to install a battery ESS that is connected to the grid then they should not be allowed to install a battery ESS simply

because it is powered by a different energy source.

+This letter enclosed an ESS battery safety research study that will be addressed in a separate section of this report.

TABLE SIX: Summarizes 6 letters CSLB received from various elected officials. The letter used by elected officials is the same template referred to earlier in this section (see page 50 of this report). For reader convenience, the template is duplicated again here as follows (emphases in original):

> Thank you for your continued efforts to protect California consumers by ensuring the construction industry adheres to policies that promote the health, safety and general welfare of the public. We are appreciative of the thorough review the Board has taken in recent months and are writing to **urge the Board to clarify current regulations to require that only specialty contractors holding a C-10 electrical contractors license may install battery energy storage systems**.
>
> The use of battery energy storage systems is rapidly expanding in hospitals, schools, businesses and homes throughout the state. This technology is key in helping California meet its clean energy and emissions reduction goals and to expand the adoption of solar, wind and other clean energy sources. However, if not installed and maintained correctly by highly-qualified and licensed C-10 electrical contractors, battery energy storage systems pose unique fire, electrical and public safety risks to installers, consumers, utility workers and emergency personnel. Ambiguity in the regulations has allowed C-46 solar contractor licensees to install battery energy storage systems when paired with a solar photovoltaic (PV) system, even though these battery energy storage systems are separate electrical systems and the C-46 solar contractors do not have the electrical training or expertise required.
>
> A PV energy system is very different technology than a battery energy storage system. A battery **transforms** electrical energy to chemical energy and back into electricity. For that reason, CSLB regulations specifically require a C-10 license to "*install, erect or connect any electrical wires, fixtures, appliances, raceways, conduits, solar photovoltaic cells or any part thereof, which generate, **transmit**, transform or utilize electrical energy in any form or for any purpose*."
>
> C-10 licensed electrical contractors have an extensive background in electrical theory and, by law, are required to install battery energy storage systems with highly trained electricians who have been certified by the state. In contrast, C-46 licensed solar contractors are not specifically qualified to safely install this complex technology and their installing employees have no training nor certification requirements.
>
> **We are urging the Board to not compromise safety standards by continuing to allow a C-46 solar contractor to install a battery energy storage system.** CSLB regulations specifically prohibit C-46 solar contractors from installing standalone battery energy storage systems.
>
> Please adhere to the mission of the CSLB and protect public safety and consumers by ensuring battery energy storage systems are installed by only contractors who hold a valid C-10 electrical contractors license.

LETTERS FROM ELECTED OFFICIALS ON BEHALF OF LIMITING THE INSTALLATION OF ENERGY STORAGE SYSTEMS TO C-10 CONTRACTORS			
#	Date	Author	Comments
1.	3/5/19	City Councilwoman	Template
2.	3/5/19	Vice Mayor (City)	Template
3.	3/4/19	City Councilwoman	Paragraph 2 and paragraph 6 of Template
4.	4/25/18	County District Supervisor	Template
5.	3/6/19	CA State Assembly Member	Template
6.	3/7/19	28 Members of the Legislature and 23 local or state officials	Template

TABLE SEVEN: Summarizes 3 letters CSLB received from law firms, as follows:

LETTERS FROM LAW FIRM ON BEHALF OF LIMITING THE INSTALLATION OF ENERGY STORAGE SYSTEMS TO C-10 CONTRACTORS			
#	Date	Author	Comments
1.	5/17/18	Counsel for Electrical Association	Cornerstone of health and safety of any worker is their training, experience and qualifications, especially for the performance of ESS. This work has become more complex and these systems have evolved. OSHA certification is not an acceptable qualification of an electrical worker. OSHA certification covers basic concepts that do not suffice for CE training.
2.	5/18/18	Counsel for Electrical Workers	A C-46 is strictly limited to work required for the installation of a PV system alone. PV and ESS are separate systems with separate risks. Proper installation requires trained and skilled workers. The basic purpose of an ESS is to store or capture the electricity generated by an electrical generating system, for distribution. Solar energy systems generate or produce electricity. An ESS is not required to install a PV system. Separate codes, installation, and fire and life safety standards apply to solar PV and ESS. Battery fires and explosions are becoming more and more common as ESS industry expands. Letter attaches series of exhibits: (1) declaration of an individual; (2) National Electrical Installation Standards – recommended practice; (3) documents describing ESAMTAC (ESS and Microgrid Training and Certification program); (4) Battery ESS: a guide for electrical contractors (Australia); (5) S. Vorrath, Household Battery Storage is a Game Changer (Nov. 25, 2015); (6) ESS Safety: Comparing Vanadium Redox Flow and Lithium-Ion Based Systems, Energy Response Solutions (Aug. 2017) (7) Fire Codes for ESS; Klausbruckner.com; (8) How Safe are Utility-Scale ESS? Energyskeptic.com (6/2015); (9) P. Rogers, Response to ESS, fireengineering.com (6/2015) (10) U. Irfan, Battery Fires Reveal Risks of Storing Large Amounts of Energy, Scientific American (Nov. 2011); (11) Lithium-ion Battery ESS: The Risks and How to Manage Them, AIG Energy Group; (12) Blum and Long, Hazard Assessment of Lithium Ion Battery ESS, Fire Protection Research Foundation (2/2016)

3.	5/18/18	Counsel for Utility Workers	The amount of solar PV and energy storage systems connected to utility distribution systems is increasing. Both state law and CPUC directives set ambitious goals for the procurement of solar and energy storage capacity by utilities, and utilities continually exceed them. Utilities support ESS installation and their employees have the biggest stake in their success and safety. ESS has evolved beyond lead-acid and are bigger safety risk. Modern ESS is not yet mature and is changing; each system carries distinct risks and the Fire Code subjects certain systems to extra requirements. NEC provides that PV and ESS are separate systems. The storage of energy is what makes ESS dangerous; hazards of PV do not compare to the risks of combustion, explosion, and hazardous material or gas leaks posed by ESS. ESS can range from 12v lead acid to systems over 100MW in size. Residential ESS projects are relatively small in comparison. PV and ESS are separate systems. Letter attaches series of exhibits: (A), (B) and (C) are letters from utilities summarized in the Utility table above.; (D) article, CPUC Requires Additional 500MW of ESS from CA IOUs; (E) 2016 SGIP Advanced ESS Impact Evaluation – report to So. CA. Gas Co. 8/2017); (F) 2016 SGIP Handbook; (G) 2017 NEC § 706.1; (H) CA Fire Code § 608.1-13; (I) CPUC, Relevant CPUC, Energy Comm. And ISO Proceedings & Initiatives; (J) CPUC Issues, priorities and Recommendations for ESS Interconnection Staff Proposal; (K) PG&E Application of PG&E for Approval of Agreements Resulting from its 2016-17 ESS and Cost Recovery (12/2017)

SECTION 6:

Other Considerations in ESS

Public Safety: Testimony and Letters

As documented in this report, information obtained from industry experts, utility representatives, and building and fire department officials state that ESS installations may pose a health and safety risk. Many of the letters summarized in this report state that ESS systems pose unique and particularly hazardous safety, fire and electrocution risks, and that improperly installed systems cause hazards and can overheat, explode, create arc flashes and blasts of electricity, or burst into flames.

The letters and public hearing testimony detail anecdotal reports of electrical accidents; however, none of these reports detail the license classification(s) involved or whether an energy storage system was a cause of the event. Some of the anecdotes explain that the parties involved were not certified electrician. As for battery safety itself, in one letter from a law firm summarized in this report, an exhibit was included from the "Energy Storage and Microgrid Training and Certification Center" (ESAMTAC). It detailed the following incidents:

- Two fires at lithium ion battery plants in 1995, and 2007, respectively.
- 2006 massive global recall of lithium-ion laptop batteries.
- Chevrolet Volt investigated for fires in 2011 and 2012 that destroyed garages in Connecticut and North Carolina.
- Boeing 787 "Dreamliners" grounded by federal regulators until the lithium-ion batteries in the model are "safe and in compliance"
- Three fires reported in Tesla Model S in 2014
- Lithium-ion batteries banned as cargo on passenger planes.
- Hoverboards recalled over battery fires and explosions.

Another exhibit in the same letter from the law firm includes an article "Household battery storage is a game changer – but is it safe?" by Sophie Vorrath, November 25, 2015 (https://onestepoffthegrid.com.au), an Australian article. The article states that "we have heard [battery storage] described, on numerous occasions by various energy industry insiders, as the most dangerous item you will ever put in your house." The

article states that “it takes years to understand lithium-ion batteries” and that “you’re putting a full power plant in your home.” The Australian article lists several recommendations for energy safety, such as improving regulations and building codes.

Finally, letter number 2, dated February 20, 2018, and summarized in Table 5 of the “Letters from the Public on Behalf of the C10 Industry” in this report (see page 58), enclosed a research study commissioned by the State of New York and local utilities, who conducted extensive fire and extinguisher testing on a broad range of ESS battery chemistries, including lithium-ion and lead acid. The study issued the following findings:

> The main conclusion from the program is that installation of battery systems into buildings introduces risks, though these are manageable within existing building codes and firefighting methods when appropriate conditions are met.
>
> Existing building codes and engineering controls can be adequate in many cases to handle battery safety issues.
>
> The toxic emissions from fires in this study can be managed by today’s engineering controls and are not anomalous or excessive when compared to a plastics fire. Plastics fires can generate similar gases in larger quantities over the average emissions duration on an equivalent mass basis.
>
> Many historic battery incidents are due to external damage factors which have created confusion and overreaction to the topic of battery safety.
>
> All energy systems carry with them a risk in their deployment; however, the risks identified in this study are manageable within the limits of today’s engineering controls for safety when appropriate conditions are met.

CSLB and OSHA Records on Battery ESS Safety or Complaints

The CSLB has solicited but not received examples of workmanship, or serious injury or death that has resulted from installation of ESS paired with solar photovoltaics. As for its own records, the CSLB polled its enforcement field offices to determine if in the past calendar year, if any of the 21,301 complaints CSLB opened involved energy storage systems. The field offices reported zero results.

The CSLB also received a report from the California Division of Occupational Safety and Health on the injuries reported over the last fiscal year in the Department of Industrial Relations’ electrical classification, and none of the reports identified accidents involving the installation of battery energy storage systems.

Electrician Certification Requirement

One of the central themes of the testimony and correspondence reviewed is the fact that battery energy storage systems involves the connection of electrical devices and the employees of C-10s, who are required to be certified electricians, are the appropriate persons to make those connections.

Labor Code (LC) 108.2 requires electrician certification for all persons who engage in the connection of electrical devices for C-10 Electrical contractors licensed pursuant to Section 7058 of the Business and Profession Code (BPC). However, LC section 108.2 provides for an electrician certification exception for persons performing work for contractors licensed as class C-7 low voltage systems or class C-45 electric sign contractors as long as the work performed is within the scope of the class C-7 or class C-45 license, including incidental and supplemental work as defined in BPC Section 7059 , and regardless of whether the same contractor is also licensed as a class C-10 contractor.

There are 79,502 licensed C-10 contractors in California, and 2,108 licensed C-46 contractors in California. A total of 606 contractors hold both licenses. LC 108.2 does not provide an exception for the 576 licensed contractors that have a C-46 Solar and C10 Electrical classification. CSLB has consistently required electrician certifications for C-10 contractors employing workers that “engage in the connection of an electrical device” notwithstanding the contractor may have an A General Engineering or B General Building classification, in addition to a C-10 Electrical classification. Installing an energy storage system falls within the definition of “engaging in the connection of an electrical device”.

Other States

Many states require an electrician’s license to perform solar photovoltaics and its component parts. However, Connecticut, Florida, Hawaii, Idaho, Louisiana, Nevada, and Utah have solar licenses like California. Of these states, CSLB has been able to

determine that only Hawaii and Utah solar license classifications mention energy storage.

In Utah, one level of their multi-level solar contractor license could previously install energy storage systems as part of a solar photovoltaic system until January 2019, when the authorization was rescinded. Staff reached out to the State of Utah for information about the decision to limit their solar classification and received the following response: “there was not much discussion about this, other than the discussion that the Commission felt all E202s should be treated the same.”

In the state of Hawaii, the C-60 Solar Power systems contractor may “assemble and install photovoltaic panels, batteries, controls, and related low voltage D.C. wiring.” The C-60 Solar power systems contractor is permitted to bid, contract and install a solar power system, provided that any non-low voltage electrical work, including grounding and bonding, is subcontracted to a C-13 Electrical contractor.

CSLB staff also directly polled other state contractor licensing agency executives on whether their states have a specialty solar license and if so, if the license authorizes the installation of battery storage systems. Of the states who responded, Minnesota does not have a specific license requirement for solar PV systems, but generally requires an electrical contractor license for them. In Nevada, the installation of an ESS paired with a PV system would fall under the “Photovoltaics” subcategory of their electrical contractor’s license. North Carolina does not have a license requirement for solar PV systems, and South Carolina has a solar panel “installer” license but the license must subcontract the roof mounting and electrical contracting.

Therefore, it appears at this time that California is unique among the states to allow a contractor designated by a specialty “solar” classification to connect an energy storage system device as part of a solar photovoltaic installation, and does not in some way cap that ESS installation by voltage, or require the ESS work to be subcontracted out to, or performed under, an electrician.

SECTION 7:

Board Options and Staff Recommendation

Report Findings

The February 23, 2018 Licensing Committee Meeting Motion asks staff to conduct public meetings and report findings regarding the which, if any, of the A, B, C-10, C-20, C-36, C-46 and/or C-53 classifications should be precluded from installing an ESS in a standalone contract or when included in the installation of a solar PV system. The testimony and correspondence received focused almost exclusively on the distinctions between the C-10 and C-46 contractors and did directly not address the appropriateness of the other classifications to install ESS. This may be due largely in part to the fact that the solar language within the classification descriptions of the C-20, C-36, and C-53 contractors relates to solar heating equipment, or solar thermal, a distinct system from photovoltaics.

Nonetheless, as indicated in the timeline at the beginning of this report, CSLB has previously publicly issued what amounts to four determinations or interpretations that are not conflicting on the appropriate classification(s) to install energy storage systems. They are summarized as follows:

1. For the purposes of PV systems on residential and commercial buildings and projects that "feed into the utility grid or otherwise offset the energy costs for structures they serve," the C-10 Electrical or C-46 Solar contractor licenses are the appropriate classifications. (July 5, 2005 Letter – former Registrar Stephen Sands)

2. The C-10 Electrical Contractor may install an energy storage system as part of a photovoltaic system installation or as an independent contract. (see October 28, 2016 Enforcement Committee packet and July 18, 2017 Classification Deputy determination).

3. The C-46 Solar Contractor classification may install an energy storage system as part of a solar system installation only and may not install a standalone energy storage system. (see October 28, 2016 Enforcement Committee packet and July 18, 2017 Classification Deputy determination)

4. The A-General Engineering Contractor classification may install an energy storage system if the work includes a plant or facility to house the system. (November 15, 2016 Letter - former Registrar Cindi Christenson).

History demonstrates that regulatory change may be necessary if the Board is to limit a technology to a single classification(s). As documented in this report, between 1978 through 2009, CSLB conducted regulatory hearings to make numerous

modifications to various license classifications related to the solar industry. For example, when the SC-44 was first enacted in 1978, it was limited to solar thermal installations and was only issued to contractors holding certain classifications. But by 1983, the C-46 specialty license was created to allow contractors who wanted to specialize in solar thermal and solar photovoltaics to install those systems. Also in 1983 the C-4, C-20, C-36 and C-53 licenses were amended with "solar heating" or "solar equipment" language. And most recently in 2009, CSLB defined the C-46 classification as follows:

> A solar contractor installs, modifies, maintains, and repairs thermal and photovoltaic solar energy systems.
>
> A licensee classified in this section shall not undertake or perform building or construction trades, crafts, or skills, except when required to install a thermal or photovoltaic solar energy system.

The C-46 Solar Contractor has been installing some form of ESS in conjunction with a photovoltaic system for approximately 40 years. The Board has also continuously affirmed over the years that A-General and B-General contractors may install all solar photovoltaic systems within the context of their licenses.

On the one hand, CSLB received oral and written testimony from over 100 persons/entities that support maintaining the status quo - not limiting the C-46 license from contracting for and installing an ESS in conjunction with a PV system. In addition, staff was unable to identify significant instances of harm to persons or property caused by the installation of an ESS system. One the other hand, CSLB received oral and written testimony from more than 100 persons/entities, a petition signed by 2,500 people, and a letter signed by 28 elected officials proposing that the Board limit ESS installations to C-10s. Staff also received information obtained from industry experts, utility representatives, and building and fire department officials stated that ESS continue to evolve and the larger ESS installations may pose a health and safety risk.

One of the central themes of the testimony and correspondence reviewed is the fact that battery energy storage systems involves the connection of electrical devices and the employees of C-10s, who are required to be certified electricians, are the

appropriate persons to make those connections. Labor Code section 108.2 requires electricians be certified when they "engage in the connection of an electrical device". Industry experts and building officials confirm that more than 20% of ESS installations require an upgrade to the electrical panel and or existing electrical system. CSLB's established practice and building officials interviewed require a C-10 electrical classification to upgrade the electrical panel/system. As of March 2019, 606 licensees hold both a C-10 and C-46 classification.

Options for the Board to Consider, and Staff Recommendation

Option 1: **Take no action.**

This would retain CSLB's current determination that the A-General Engineering and B-General Contractor can install ESS within the scope of those classifications, and C-46 may contract for and install an ESS in conjunction with a photovoltaic system.

Option 2: **Recommend industry representatives seek legislation to clarify when electrician certification is required for installation of ESS under the Labor Code.**

This would provide the opportunity to either exempt classifications from electrical certification requirements or expand the electrician certification requirement to classifications in addition to the C-10 classification that hire electricians (e.g., A-general engineering, B-general building, and C-46 solar).

Option 3 and Staff Recommendation. Direct staff to consider ESS size, complexity, voltage, and potential risks, and draft proposed regulatory language to present to the Board for consideration that would prohibit or restrict certain contractor classifications from performing the installation of ESS.

As ESS is an evolving technology, this would provide the opportunity to address which contractor classifications should install ESS.

ENDNOTES

[1] Contractors State License Board (CSLB) Offers Fast Facts on Solar Projects. August 27, 2009
http://www.cslb.ca.gov/Media_Room/Industry_Bulletins/2009/August_27.aspx
[2] Contractor Classifications Authorized to Perform Projects. June 30, 2010
http://www.cslb.ca.gov/Media_Room/Industry_Bulletins/2010/June_30.aspx
[3] See p. 19, CSLB Description of Classifications, 2016.
http://www.cslb.ca.gov/Resources/GuidesAndPublications/DescriptionOfClassifications.pdf
[4] CSLB Licensing and Enforcement Committee Meetings packet. October 28, 2016. Sacramento, California. P. 55.
http://www.cslb.ca.gov/resources/BoardPackets/10-28-16_enforcement_cmte_packet.pdf
[5] Id. p. 59.
[6] See December 8, 2016 Board Meeting Minutes, p. 157, CSLB Board Meeting packet. March 13-14, 2017.
http://www.cslb.ca.gov/Resources/BoardPackets/BoardMeetingPacket2017031314.pdf
[7] See February 10, 2017 Committee Meeting Minutes, p. 81, CSLB Board Meeting packet. March 13-14, 2017.
http://www.cslb.ca.gov/Resources/BoardPackets/BoardMeetingPacket2017031314.pdf
[8] See March 13, 2017 Board Meeting Minutes, p. 314, CSLB Board Meeting packet. June 15-16, 2017.
http://www.cslb.ca.gov/Resources/BoardPackets/BoardMeetingPacket2017061516.pdf (Determination confirmed via video)
[9] The PUC notes in a December 2017 letter to the Center for Sustainable Energy that the C-46 had only been excluded from the eligible license list in previous years' versions of the SGIP handbook because the program eligibility had previously been limited to "non-solar distributed generation projects." With the proliferation in the use of and laws passed involving energy storage systems, the CSE sought to modify the SGIP eligible-contractor list to include C-46 contractors on its belief that "CSLB's current pattern and practice is to allow such installation."
[10] CSLB Licensing Committee Meeting Handouts, February 23, 2018, Sacramento, California.
http://www.cslb.ca.gov/Resources/BoardPackets/2-23-18_licensing_committee_mtg_handouts.pdf
[11] CSLB Enforcement and Licensing Committee Meetings, p. 91. February 23, 2018, Sacramento, California.
http://www.cslb.ca.gov/Resources/BoardPackets/CommitteeMeetingPacket20180223.pdf
[12] See February 23, 2018 Committee Meeting Minutes, p. 105, CSLB Board Meeting packet. April 13, 2018.
http://www.cslb.ca.gov/Resources/BoardPackets/BoardMeetingPacket20180413.pdf. See also CSLB Amended Content, April 12-13, 2018 Board Meeting, p. 31.
http://www.cslb.ca.gov/Resources/BoardPackets/AmendedMeetingPacketContent.pdf
[13] Id. p. 113. See also CSLB Amended Content, April 12-13, 2018 Board Meeting, p. 38.
http://www.cslb.ca.gov/Resources/BoardPackets/AmendedMeetingPacketContent.pdf
[14] See, respectively: Contractors State License Board (CSLB) Offers Fast Facts on Solar Projects. August 27, 2009
http://www.cslb.ca.gov/Media_Room/Industry_Bulletins/2009/August_27.aspx; Contractor Classifications Authorized to Perform Projects. June 30, 2010
http://www.cslb.ca.gov/Media_Room/Industry_Bulletins/2010/June_30.aspx; See p. 19, CSLB Description of Classifications, 2016. http://www.cslb.ca.gov/Resources/GuidesAndPublications/DescriptionOfClassifications.pdf
[15] CSLB Board Meeting packet. April 13, 2018. San Diego, California. P. 155.
http://www.cslb.ca.gov/Resources/BoardPackets/BoardMeetingPacket20180413.pdf
[16] Id.
[17] See April 13, 2018 Board Meeting Minutes, p. 300, CSLB Board Meeting packet. June 7, 2018.
http://www.cslb.ca.gov/Resources/BoardPackets/BoardMeetingPacket20180607.pdf
[18] Id. at p. 317
[19] http://www.cslb.ca.gov/Media_Room/Industry_Bulletins/2018/April_17.aspx
[20] For a copy of the videos, please contact the CSLB Executive Office: (916) 255-4000
[21] See December 13, 2018 Board Meeting Agenda, item D(2)(b).
http://www.cslb.ca.gov/Media_Room/Board_And_Committee_Meetings/2018/Board_Meeting_Agenda_December_13.aspx. At the time of this writing, the meeting minutes for this board meeting had not been published (they

are usually included in the packet of the subsequent board meeting for the Board's review and approval, which in this case would be March 2019).

[22] Register 78, No. 42.
[23] Page 105, December 10, 1981 Special Meeting of the Board, Oakland, California.
[24] Page 105, December 10, 1981 Special Meeting of the Board, Oakland, California.
[25] Page 105, December 10, 1981 Special Meeting of the Board, Oakland, California.
[26] Page 106, December 10, 1981 Special Meeting of the Board, Oakland, California.
[27] Page 106, December 10, 1981 Special Meeting of the Board, Oakland, California.
[28] Page 106, December 10, 1981 Special Meeting of the Board, Oakland, California.
[29] April 9, 1981. Letter from CSLB Energy Division Chair Kathy Ryan to the CSLB Enforcement Committee.
[30] April 9, 1981. Letter from CSLB Energy Division Chair Kathy Ryan to the CSLB Enforcement Committee.
[31] April 9, 1981. Letter from CSLB Energy Division Chair Kathy Ryan to the CSLB Enforcement Committee
[32] November 5, 1979. Letter to Local Building Officials from Registrar John F. Maloney.
[33] July 30, 1980. Letter to CSLB Enforcement Committee members from Registrar's office.
[34] January 14, 1981. Letter to General Public from CSLB Energy Division Chair Kathy Ryan
[35] March 2, 1981. Letter from Registrar John Maloney to Building Departments and Contractors.
[36] April 9, 1981. Letter from CSLB Energy Division Chair Kathy Ryan to the Enforcement Committee.
[37] September 1, 1981. CSLB Rulemaking package, notice of proposed changes in the regulations of the CSLB and Statement of Reasons.
[38] Statement of Reasons, paragraph 1.
[39] Statement of Reasons, paragraph 2.
[40] Statement of Reasons, paragraph 3.
[41] Statement of Reasons, paragraph 4.
[42] Statement of Reasons, paragraph 5.
[43] Statement of Reasons, paragraph 7.
[44] Statement of Reasons, paragraph 9.
[45] December 10, 1981: Special Meeting of the Board, Oakland, California, comments by Board Member Warren E. McNeely.
[46] Page 106-107, December 10, 1981 Special Meeting of the Board, Oakland, California
[47] Page 109-110, December 10, 1981 Special Meeting of the Board, Oakland, California
[48] Page 110, December 10, 1981 Special Meeting of the Board, Oakland, California
[49] Page 110-111, December 10, 1981 Special Meeting of the Board, Oakland, California
[50] Page 111, December 10, 1981 Special Meeting of the Board, Oakland, California
[51] Page 112, December 10, 1981 Special Meeting of the Board, Oakland, California
[52] Page 130, December 10, 1981 Special Meeting of the Board, Oakland, California
[53] Page 141, December 10, 1981 Special Meeting of the Board, Oakland, California
[54] Page 155, December 10, 1981 Special Meeting of the Board, Oakland, California
[55] Page 172, December 10, 1981 Special Meeting of the Board, Oakland, California
[56] Register 82, No. 18
[57] June 8, 1982: Memorandum to all staff "Solar Licensing Changes go into effect" from CSLB Energy Division Chair Kathy Ryan.
[58] Register 83, No. 35.
[59] April 20, 2009 hearing date, Initial Statement of Reasons.
[60] April 20, 2009 hearing date, Final Statement of Reasons.
[61] Register 2009, No. 49.

EXHIBIT ONE

CONTRACTORS STATE LICENSE BOARD
9821 Business Park Drive, Sacramento, CA 95827
Mailing Address: P.O. Box 26000, Sacramento, CA 95826
800-321-CSLB (2752)
www.cslb.ca.gov

STATE OF CALIFORNIA
ARNOLD SCHWARZENEGGER, Governor

July 5, 2005

John J. O'Rourke
International Brotherhood of Electrical Workers
Local Union 6
55 Fillmore Street
San Francisco, CA 94117

Subject: Photovoltaic Systems

Dear Mr. O'Rourke:

This letter is in response to your request for a licensing determination concerning the installation of photovoltaic systems.

Specifically, you have asked that we list the license classifications that are appropriate for photovoltaic systems that, for residential and commercial building projects, are installed for the purpose of feeding into the utility grid or otherwise offsetting the energy costs for the structures they serve. Under existing laws and regulations, contractors holding either one of the following two (2) license classifications can install any photovoltaic system without limitations:

C-10 (Electrical)
C-46 (Solar)

In addition, contractors holding the General Engineering (A) license classification or the General Building (B) classification may contract for the installation of these systems as outlined below:

1. In order for the General Engineering (A) classification to be appropriate, the system must be installed on the types of projects specified under the provisions of Business and Professions Code Section 7056 (copy enclosed).

2. In order for the General Building (B) classification to be appropriate, the prime contract must involve two or more unrelated trades, or be contracted to an appropriately licensed subcontractor as specified in Business and Professions Code Section 7057 (copy enclosed).

I trust that the foregoing information has been responsive to your request. If further clarification or additional information is needed, please do not hesitate to call my office at (916) 255-4000.

Sincerely,

Stephen P. Sands
Registrar of Contractors

EXHIBIT TWO

CONTRACTORS STATE LICENSE BOARD
9821 Business Park Drive, Sacramento, California 95827
Mailing Address: P.O. Box 26000, Sacramento, CA 95826
800-321-CSLB (2752)
www.cslb.ca.gov • CheckTheLicenseFirst.com

STATE OF CALIFORNIA
Governor Edmund G. Brown Jr.

November 15, 2016

Eddie Bernacchi
NECA Legislative and Regulatory Advocate
1127 11th Street, Suite 747
Sacramento, CA 95814-3811

Dear Mr. Bernacchi:

I am writing in response to your request for clarification from the Contractors State License Board (CSLB) on which specialty license classification should be obtained to place, install and connect an electrical energy storage system.

Energy Storage Systems (ESS) store electricity obtained when power is not being used, or "off-peak times". These stations consist of: foundations, battery containers that are set on helical piers- usually galvanized steel piers driven into the ground to a designed depth with a piece of machinery, and transformers set on concrete pads.

A microgrid is any small-scale localized station with its own power resources, generations and loads, and definable boundaries.

There are two classifications that can install microgrids or an ESS. The C10 – Electrical classification is most appropriate to install the ESS systems in existing structures. The A – General Engineering classification would be appropriate if the work also included a plant or facility to house the ESS system.

I hope this information is helpful.

Sincerely,

Cindi Christenson
Registrar

EXHIBIT THREE

CONTRACTORS STATE LICENSE BOARD
9821 Business Park Drive, Sacramento, California 95827
Mailing Address: P.O. Box 26000, Sacramento, CA 95826
800-321-CSLB (2752)
www.cslb.ca.gov • CheckTheLicenseFirst.com

STATE OF CALIFORNIA
Governor Edmund G. Brown Jr.

July 18, 2017

Jonathan Hart
Center for Sustainable Energy
9325 Sky Park Court, STE 100
San Diego, CA 92123

Mr. Jonathan Hart,

This letter is to follow up the email you sent requesting verification of the appropriate classifications to perform installation of an energy storage system as part of a solar installation.

The C46 – Solar classification may install energy storage systems as part of a solar system installation. The C10 – Electrical classification may install energy storage systems as part of a photovoltaic system installation as well as an independent project.

This determination is not a formal declaratory decision under the comprehensive process in the Administrative Procedures Act. I trust that the foregoing information has been of assistance to you.

Andrea Sisto
Classification Deputy
classifications@cslb.ca.gov