**Lighting Retrofit Disposition Summary of Changes**

**High Bay and HID Technologies and Hard-wired Exterior Lighting**

November 25, 2014

Part 3 (of 3): Retrofits of fixtures installed in high-bay applications, hard-wired exterior lighting, or measures which include high intensity discharge (HID) technologies including 224 measures from 31 IOU workpapers.

1. **Requirements for Proposed Early Retirement Deemed Measures Not Met:** Many submitted workpapers include measures explicitly or implicitly[[1]](#footnote-2) defined as early retirement either without any code baseline or with an incorrect code baseline. The request to claim a retrofit project measure as an early retirement (ER) measure invokes the requirement for documentation of the pre-existing condition as well as a preponderance of evidence that the program intervention caused the early retirement project. Per D.12-05-015 (at 346) “it is necessary to establish, by a preponderance of evidence, that the program has induced the replacement rather than merely caused an increase in efficiency in a replacement that would have occurred without the program”. For downstream deemed measures the workpapers have not met the burden of preponderance of evidence to support an early requirement claim. At this time, deemed measures can only be claimed as ER by direct install programs. IOUs shall resubmit their 2013-2014 claims for downstream early retirement with the measure application type revised to ROB. Starting January 1, 2015, deemed measures can only be claimed as ER by direct install programs in cases where the adopted ER evidence and documentation of pre-existing equipment requirements have been met. For downstream applications, IOUs shall submit, in workpapers for staff review and approval, research and documentation that supports the claim of early retirement in downstream rebate applications.
2. **Incorrect or Omitted Code Baseline Assignments:** As part of the effort to improve the review of all lighting workpapers, the ex ante team converted all workpaper measures into the DEER ex ante database measure format. Once this was complete, it became obvious that many measures were defined in IOU workpapers as ROB with baseline fixtures that did not include correct code baselines as required by DEER and covered by direction in D.12-05-015. For example, many measures involved replacing incandescent, mercury vapor high bay or standard metal halide technologies with linear fluorescent fixtures. Since these baseline technologies, do not meet DEER requirements for code baselines, the ex ante team was left with the choice of either changing the ROB baseline to match the DEER requirements or redefining these measures to be early retirement and then inserting the code baseline. The ex ante team chose the latter as it left open the possibility to still claim early retirement provided the evidentiary requirements set by policy are met.

Staff developed a background document (sent with the Linear Fluorescent Summary of Changes document on October 31, 2014) covering the basis for establishing code baselines as well as justification for applying code baselines retroactively to January 1, 2013[[2]](#footnote-3). On page 4, the following code baselines are summarized, based on DEER 2011 as amended and adopted according in D.12-05-015:

*Four foot T8 measures: The code baseline is either first or second generation T8 lamps with normal light output electronic ballasts.*

*Other four foot linear fluorescent measures: DEER requires second generation T8 lamps with normal light output electronic ballasts as the code baseline. However, Attachment A* [to D.12-05-015] *revised the code baseline for T5 measures to be the measure technology in cases where the T8 code baseline would result in negative above code savings.*

*Linear fluorescent measures with other than four foot lamps: Here, DEER requires second generation T8 lamps, however, the “generation” of the T8 lamp is only applicable to four foot lamps where first, second and third generation lamps (each successive generation with better performance and efficiency characteristics than the previous). For other length lamps, there has not been the progression of increased performance and efficiency. This creates some ambiguity for establishing code baselines for these technologies (see next section.)*

*HID measure technologies: The code baseline for all HID measure technologies are pulse start metal halide technologies.*

The Phase 1 lighting disposition (page 5) provides the following additional direction on the establishment of code baselines[[3]](#footnote-4)

*Follow DEER requirements for establishing default code baselines for all fixtures: In general, code baselines are as follows:*

1. *4’ linear fluorescent measures shall have a code baseline of 2nd generation T8 lamps and electronic, normal light output, ballasts*
2. *All other linear fluorescent measures shall have a code baseline of T8 lamps and electronic, normal light output, ballasts*
3. *High bay measures using linear fluorescent technologies depend on whether the project is a major retrofit. Major retrofits have linear fluorescent code baselines, otherwise the code baseline [is] a pulse start metal halide technology.*
4. **Early Retirement of Incandescent, Mercury Vapor and Standard Metal Halide Technologies:** 74 measures involve the retrofit of mercury vapor (MV), standard metal halide, with lamps of at least 150 watts (MH), and incandescent technologies to a broad range of generally more efficient technologies including:

* Pulse start metal halide (PSMH) lamps with standard constant wattage autotransformer (CWA) ballasts
* PSMH lamps with electronic ballasts
* LED fixtures
* Induction lamp and ballast technologies
* Compact fluorescent lamp and ballast technologies

All such workpaper measures utilized pre-existing equipment as the baseline[[4]](#footnote-5),[[5]](#footnote-6) and utilized wattages above the adopted DEER[[6]](#footnote-7) code baseline wattages[[7]](#footnote-8). Therefore, the ex ante team has revised these measures to ensure that they are correctly defined for both early retirement and ROB/NC implementations. Incandescent, MV and MH technologies cannot be used as baselines in ROB measures as they do not meet the requirements for code baselines as discussed in Section 2, above. For this group of measures, the ex ante team was left with the choice of either changing the ROB baseline to match the DEER requirements or redefining these measures to be early retirement and then inserting the code baseline. Staff chose the latter as it left open the possibility to still claim early retirement provided the evidentiary requirements set by policy are met. For each of these measures, the ex ante team added code baseline technologies that meet DEER requirements. All of these measures are covered by direction given in D.12.05.015, its Appendix A, or its adopted DEER2011. Therefore, the disposition on these measures will be effective January 1, 2013. PAs are responsible for implementing workpaper ex ante values following direction in previous Decisions, regardless of whether those values are reviewed and explicitly addressed through a disposition. Appropriate use of DEER assumptions, methods and data was directed by D.12-05-015 OP 143, with the added direction that Commission staff shall make the determination of the appropriateness of the application of DEER to non-DEER values. Further details for the different measure technologies are described below:

1. Measure technologies without documented lumen output: The ex ante team’s approach to establishing code baselines is to select the PSMH fixture with approximately the same mean lumen output as the measure fixture. However, workpapers for LED, induction and CFL technologies do not include estimates of mean lumen output for measure technologies. For these measures, the ex ante team assigned code baselines consisting of PSMH fixtures with mean lumen output approximately equal to the mean lumen output of the pre-existing technology.
2. Pulse start metal halide lamps with electronic ballasts: For these high efficiency HID fixtures, the ex ante team assigned code baselines of PSMH fixtures with mean lumen output approximately equal to the mean lumen output of the measure technology.
3. Pulse start metal halide lamps with standard CWA ballasts: Since these technologies match the DEER code baseline, these measures are classified as “to-code” measures. In the case of to-code measures, if early retirement, savings can only be claimed for the RUL period. However, policy requires that utility energy efficiency incentive based programs only support projects which exceed codes, standards and regulations; except when to-code programs are specifically authorized. These ER measures utilize technologies which only meet, but do not exceed, current codes, standards, or regulations and as a result they are not considered by Commission staff to be eligible for Program participation. Commission staff directs the PAs to remove these to-code measures from their portfolios no later than December 31, 2014. Commission staff additionally makes the strong point that claiming an early retirement measure invokes the requirement for documentation of the pre-existing condition as well as evidence that program intervention caused the early retirement project (per D.12-05-015). Additional direction for deemed early retirement measures is included in Section 1, above.
4. **Retrofits Installing Linear Fluorescent Measure Technologies**: 41 measures involve the replacement of conventional HID technologies (such as mercury vapor or metal halide) with linear fluorescent fixtures. The measure technologies are defined as fixtures with either T8 lamps or T5 lamps. Additionally, some measures are defined by wattage ranges, with savings being based on a selected wattage the Program Administrator proposes as the typical wattage the range. As discussed in items 1 and 2 above, any measures with baselines that are less efficient (or have higher wattage) than the DEER code baselines are, by definition, early retirement measures. These measures must be defined to include a code baseline and may only be claimed where evidence requirements are met. Table 1 provides examples of how these measures are defined by PG&E, SCE and SDG&E.

**Table 1 - Example High-Bay Linear Fluorescent Measures from PG&E, SCE and SDG&E**

| **IOU** | PG&E | SCE | SDG&E |
| --- | --- | --- | --- |
| **Workpaper ID** | PGECOLTG114 | SCE13LG086 | WPSDGENRLG0044 |
| **Workpaper Title** | Non Residential Interior High Performance Linear Fluorescent Fixtures with NEMA Premium HE Ballast | Interior Linear Fluorescent Fixture | Interior Linear Fluorescent Fixture |
| **Measure Application Type** | ROB | Retrofit (Early Retirement) | Retrofit (Early Retirement) |
| **“At a Glance” Summary** | Replace, one-for-one, existing incandescent, mercury vapor, standard metal halide or high pressure sodium fixtures in interior applications with complete high performance, HP T8 lamp/fixture and NEMA premium Hi-Efficiency Ballast (identified as low ballast factor <= 0.80), lower wattage than the fixture being replaced. | This work paper documents the E3 Calculator input values for replacing existing interior lighting fixtures with more efficient linear fluorescent fixtures (T8, T5, or T5HO). The existing interior lights being replaced must be incandescent, mercury vapor, standard metal halide, or high pressure sodium. | Fixtures must be equipped with linear fluorescent lamps and ballasts that meet the specifications defined in the T8 or T5 Linear Fluorescent Lamps with Electronic Ballasts category. New fixtures must replace one-for-one, existing Incandescent, Mercury Vapor, T12/High Output Fluorescent, T12/Very High Output Fluorescent, Standard Metal Halide, or High Pressure Sodium Fixtures in interior installations. |
| **Sample Measure ID and Description** | L1035: 400 Watt lamp base case, up to 244 Watt replacement fixture (Tier 1) | LT-26100: Up to 244 Watt (Tier 1) Interior Fixture T5 Linear Fluorescent replacing 400 Watt lamp base case | LH-21: Up to 244 Watt (Tier 1) Interior Fixture T5 Linear Fluorescent replacing 400 Watt lamp base case |
| **Technology Definitions** | Baseline: DEER 2011 Technology MV-400w(455w) baseline watts = 455  Measure: DEER 2011 Technology LFLmpBlst-T8-48in-32w-2g+El-IS-RLO(96w) measure watts = 96 | Pre-existing: DEER 2011 Technology MH-400w(458w) pre-existing watts = 458  Measure: DEER 2011 Technology LFLmpBlst-T5-46in-54w+El-PS-HLO-2(234w) measure watts = 234 | Pre-existing: DEER 2011 Technology MH-400w(458w)) pre-existing watts = 458  Code: DEER 2011 Technology PSMH-350w(400w) code watts = 400  LFLmpBlst-T5-46in-54w+El-PS-HLO-2(234w) measure watts = 234 |
| **Fixture Watts and Wattage Reduction** | Fixture Watts:  Pre-existing: 455 w  Code baseline: none defined  Measure: 96 w  Delta Watts:  Pre-existing: 359 w  Code: none defined | Fixture Watts:  Pre-existing: 458 w  Code baseline: none defined  Measure: 234 w  Delta Watts:  Pre-existing: 224 w  Code: none defined | Fixture Watts:  Pre-existing: 458 w  Code baseline: 365 w  Measure: 234 w  Delta Watts:  Pre-existing: 224 w  Code: 166 w |
| **Mean Lumen Output** | Pre-existing: 18,700  Code Baseline: none defined  Measure: 11,286 | Pre-existing: 22,000  Code Baseline: none defined  Measure: 20,900 | Pre-existing: 22,000  Code Baseline: 21,000  Measure: 20,900 |

SCE’s measure definition matches a measure that exists in DEER 2011, but did not include the code baseline. SDG&E’s definition matched the DEER definition with the exception of inclusion of an incorrect code baseline technology. For these measure as well as all other linear fluorescent high-bay measures, the ex ante team inserted the proper code baseline for the DEER measure or, if not a DEER measure, the code baseline that is consistent with DEER methods and assumptions as directed in 12-05-015.

The PG&E measure definition is proposed as an ROB measure. However, the pre-existing, mercury vapor fixture does not meet DEER requirements for code baseline. Therefore, the measure must be redefined in one of two ways:

1. Kept as ROB, but the pre-existing fixture changed to match the DEER code baseline requirements, or
2. Change the measure to an ER measure and insert a code baseline from which the savings are calculated for the second savings period (EUL – RUL).

The DEER code baseline for four foot linear fluorescent measures is 32 watt 2nd generation T8 lamps with normal light output electronic ballasts. The measure fixture incorporates three 2nd generation lamps with a reduced light output ballast and a total fixture input power of 96 watts. The code baseline has the same number of 2nd generation T8 lamps, a normal light output electronic ballast and a total fixture input power of 118 watts. Therefore, a correct application of the DEER code baseline would reduce the above code and ROB savings of this measure from 359 to 22 watts, about a 95% reduction in savings.

Because of the severity of this savings reduction, the ex ante team reviewed claims for these measures in an effort to assess how this would affect PG&E’s overall portfolio of savings. During this review, the ex ante team identified that PG&E had appeared to use different measure descriptions in their claims when compared to the measure definitions in the workpapers. For example, the measure described in Table 2 “Replace one-for-one existing Mercury Vapor fixture 455W with HP T8 96W fixture (4' fixture with 4 lamps)” with solution code L1035 is listed in the claims as “HO T-5 FIXTURE: INTERIOR, METAL HALIDE, 4 LAMP CONV, TIER-1 400 < 244 – HP” which is identical to a measure definition in SCE’s workpaper (SCE solution code LT-26100). Staff concluded that there was a high likelihood that these measures were the same as those defined in the SCE and SDG&E measures and were actually T5 measures, not T8 measures, and therefore revised the measure definitions to match the SCE and SDG&E definitions. As discussed above, proper application of DEER code baselines to PG&E’s claims, using PG&E’s measures as defined in workpapers, would have reduced PG&E’s claimable ROB savings by 90% or more. Redefining these measures to match SCE and SDG&E measures reduces PG&E’s claimable savings by about 60%. The overall effect of these revisions on PG&E’s 2013 claims is to reduce their accomplishments for their high-bay linear fluorescent measures by about 45%.

As shown in Table 1, the original PG&E measure definitions show that the measure technology performance in terms of overall light output is substantially less than the pre-existing technology performance while the SCE and SDG&E definitions provide roughly equivalent performance. CPUC policy defines energy efficiency to be the installation of technologies that results in reduced energy consumption for the same level of service. In some cases, pre-existing technologies may result in over-lit conditions and part of the retrofit involves installing technologies that provide more appropriate lighting levels for the current application. These retrofits must be classified as early retirement. The code baseline for these measures must provide a level of service equivalent to the measure technology, not the pre-existing technology. Therefore, the savings associated with reduction in light output may only be claimed for the RUL period.

Moving forward, workpapers for high-bay linear fluorescent measures must define measures in greater detail and meet the following requirements:

1. Measure definitions may not cover both T8 and T5 technologies and may not define measures in terms of ranges of pre-existing or measure technology input power ratings.
2. Each linear fluorescent technology must be its own measure.
3. Code baselines for T5 measures must be PSMH technologies with similar mean lumen output as the measure fixture.
4. Code baselines for T8 measures must consist of 2nd generation T8 lamps, normal light output electronic ballasts and the same number of lamps as the measure fixture.
5. Measures with pre-existing technologies that do not meet DEER code baseline requirements shall be defined as early retirement. As discussed above for downstream deemed measures, the workpapers have not met the burden of preponderance of evidence to support an early requirement claim. Commission staff directs that until such time as the ER evidence requirements have been met, reviewed and approved, deemed ER measures can only be utilized in direct install programs in cases where the adopted ER requirements are met.
6. Code baseline and measure technologies must provide similar level of service. At this time, staff accepts the use of mean lumen output for determining level of service, however, staff encourages PAs to research and propose other methods for establishing similar level of service[[8]](#footnote-9). Measures that assume pre-existing technologies with higher lumen output must be classified as early retirement with savings due to the lower overall light output claimable for the RUL period only.
7. Measures consisting of 2nd generation T8 lamps with normal light output electronic ballasts are considered “To Code” measures and shall not be included in program offerings after **<Need Date>.**
8. **Measures Unaffected by This Disposition:** 109 measures are defined as replace-on-burnout (ROB) measures where the pre-existing technologies meet or exceed the DEER code baseline requirements. At this time, staff accepts these measure definitions as ROB with full savings calculated above the baseline using the EUL of the measure fixture. However, the ex ante team is concerned that, within this group of measures, some are defined in such a way that they do not provide a similar level of service as the base fixture. The determination of the ROB baseline likely involves the analysis of expected lighting power levels across a set of DEER building types and determining typical code compliant technologies that provide the same level of lighting performance for a range of typical new construction and normal replacement projects.
9. **Response to IOU Comments**: In their comments covering the May version of the disposition, PAs noted some input wattages for some fixtures that appeared to typographical errors, perhaps where wattages were incorrectly translated from the workpapers. The ex ante team will be correcting any of these errors as part of the final disposition.

1. We use the term implicitly here to describe the case where the workpaper uses a “below code” technology baseline assumption but does not label the measure as early retirement and or in some cases labels the measure as replace-on-burnout (ROB). [↑](#footnote-ref-2)
2. Explaining the Retroactive Application of Adopted DEER Code Baselines for Lighting Measures, October 23, 2014 [↑](#footnote-ref-3)
3. *Workpaper Disposition for Lighting Retrofits California Public Utilities Commission, Energy Division March 1, 2013* [↑](#footnote-ref-4)
4. D.11-07-030, attachment B at B13 and amplified by D.12-05-015 at 346 states that pre-existing replaced equipment can only be used as the savings calculation baseline when the preponderance of evidence establishes that the replacement was induced by the program. [↑](#footnote-ref-5)
5. D.12-05-015 at 351 notes that “regressive” baselines and like-equipment replacements would not normally be allowed for energy efficiency upgrades. [↑](#footnote-ref-6)
6. DEER2011 adopted for use in 2013-2013 program by D.12-05-015 set the code baseline equivalences for all linear florescent measures. See the DEER2011 document “Appendix A-1:DEER Measure Database Updates Measure content, modeling method, model input parameter, and database format changes” at A-1-12 and D.12-05-015 Attachment A at 10. [↑](#footnote-ref-7)
7. CPUC early retirement policy requires that a second baseline be determined that represents the likely system to be installed at the end of the remaining useful life (RUL) of the pre-existing system. With recent Title 24 changes that became effective on 7/1/2014, all lighting system replacements must meet restrictions on lighting power density. Any code baseline approach for deemed lighting, must consider the impact of these Title 24 revisions on the expected installed lighting power and the lighting technologies that will likely meet those requirements. Alternatively, projects may be implemented via calculated approaches where permit information and supporting documentation show the installed lighting power allowed under new Title 24 requirements. [↑](#footnote-ref-8)
8. The use of reduced light output ballasts (in either DEER or workpaper measures) results in a fixture with lower overall light output than the applicable DEER code baseline fixture which assumes a normal light output ballast. CPUC policy defines energy efficiency to be the installation of technologies that results in reduced energy consumption for the same level of service. This means that measures of this type likely do not align with CPUC policy – energy efficiency savings credit is being given for a measure that provides a reduced service level; the baseline for these measures may need to be adjusted to take service level into consideration. This problem can be addressed for custom measure approaches, since it is acceptable to determine the Title 24 compliant lighting power allowance with the above code savings calculated above this level. However, deemed measures require selection of a technology as the code baseline. The determination of this code baseline likely involves the analysis of expected lighting power levels across a set of DEER building types and determining typical code compliant technologies that provide the same level of lighting performance for a range of commonly encountered pre-existing technologies. [↑](#footnote-ref-9)