



Designation: ~~E3183 – 19~~ E3183 – 24

## Standard Guide for Harvesting Coal Combustion Products Stored in Active and Inactive Storage Areas for Beneficial Use<sup>1</sup>

This standard is issued under the fixed designation E3183; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

### 1. Scope

1.1 This guide ~~provides~~covers a framework to address critical aspects related to the *harvesting* of *CCPs* placed in *active* (operational) and *inactive* (closed or no longer receiving *CCPs*) *storage areas*. These storage areas may be used for wet or dry material, and may be located at *active* or *inactive facilities* (that is, coal-fired electric utilities or independent power producers that are currently generating electricity or have ceased to do so, respectively). Also, *CCPs* may be harvested from *active* or *inactive storage areas* located on-site or off-site of the *facility*.

1.2 This guide does not include information on how to determine what *storage areas* or facilities, or both, should be selected for potential *harvesting* of *CCPs*, as each entity may approach a *harvesting* program in accordance with their own *harvesting* pursuits and regulatory requirements. In addition, it does not include information on how an energy company or other interested parties should evaluate inventories to determine the order of their *storage areas* for potential *harvesting*, including consideration of risk, performance, and cost. This guide is intended to be used to evaluate the potential *harvesting* of the *storage areas* once the *storage areas* are selected for evaluation.

1.3 This guide is comprised of the following sections: Scope, Section 1; Referenced Documents, Section 2; Terminology, Section 3; Significance and Use, Section 4; Project Planning and Scoping, Section 5; Background Review of *CCP Storage Areas*, Section 6; Detailed Characterization of *CCP Storage Areas*, Section 7; *Harvesting* Planning and Scoping of *CCP Storage Areas*, Section 8; *Harvesting* Detailed Design and Approval (as applicable) of *CCP Storage Areas*, Section 9; and *Harvesting* Implementation of *CCP Storage Areas*, Section 10. Not all information within this guide will be necessary for each *harvesting* project, and the user should determine the applicability of each section.

1.3.1 Section 1, Scope, includes information related to contents of this guide, as well as what is not included in this guide.

1.3.2 Section 2, Referenced Documents, includes published documents referenced within this guide.

1.3.3 Section 3, Terminology, includes definitions for terms as they relate to this guide.

1.3.4 Section 4, Significance and Use, describes the *beneficial use of CCPs* stored within *active* and *inactive storage areas*, including each *CCP* potential beneficial use; the context of the guide and its use; the professional judgment that is appropriate for use of the guide; and the inherent uncertainty with the processes described within the guide.

1.3.5 Section 5, Project Planning and Scoping, describes the steps needed prior to implementing this guide, including: establishing

<sup>1</sup> This ~~test method~~ guide is under the jurisdiction of ASTM Committee E50 on Environmental Assessment, Risk Management and Corrective Action and is the direct responsibility of Subcommittee E50.03 on Beneficial Use.

Current edition approved Nov. 1, 2019; Feb. 1, 2024. Published December 2019; April 2024. Originally published in 2018. Last previous edition approved in 2018 as E3183E3183 – 19, –18; DOI: 10.1520/E3183-1910.1520/E3183-24

a *project team*; determining what *storage areas* within the *facility* should be evaluated for potential *harvesting* of *CCPs*; determining the potential materials to be harvested; compiling existing land use, environmental compliance, geologic/hydrogeologic, topographic, design and construction information; estimating potential project costs and project schedule with contingencies (if feasible); and identifying factors that may impact the ability to harvest the *CCPs*.

1.3.6 Section 6, *Site Background Review of CCP Storage Areas*, describes the steps for evaluating the attributes of *storage areas* at the *facility* relative to *harvesting CCPs*.

1.3.7 Section 7, *Detailed Characterization of CCP Storage Areas*, describes the steps for developing and implementing the *CCP* characterization sampling and analysis plan that will evaluate the chemical and physical characteristics of the *CCPs* within the *storage areas*, and determining if amendments to the *CCPs* will be needed for beneficial use.

1.3.8 Section 8, *Harvesting Planning and Scoping of CCP Storage Areas*, describes the steps necessary to evaluate the approval status of the *storage areas* and develop a conceptual *harvesting* strategy and approval approach for the project. Considerations are given for both *active* and *inactive storage areas*.

1.3.9 Section 9, *Harvesting Detailed Design and Approval* (as applicable) of *CCP Storage Areas*, describes the steps needed to prepare the detailed design and approval documents (as applicable) for the *CCP storage area harvesting* and receive the appropriate approval (as applicable).

1.3.10 Section 10, *Harvesting Implementation of CCP Storage Areas*, describes the steps needed to implement the *storage area harvesting* plans from installation of the appropriate pre-*harvesting* components and *harvesting* the *CCPs* in accordance with the approval requirements, to completing the post-*harvesting* monitoring and inspections.

1.3.11 Sections 6 through 10 provide the five phases (Phase I through V) of the *harvesting* process that follow once *storage areas* are selected for *harvesting* evaluation. Information related to Phase I through V is located on Table 1.

1.4 This guide does not include information on the *processing* of harvested *CCPs*, and therefore, additional approvals not discussed within this guide may be needed (for example, residual waste *processing* approvals, air approvals specific to *processing*, water control approvals, storage system approvals, etc.).

1.5 As *CCPs* are produced, they may be sent off-site directly to beneficial use applications, such as concrete, wallboard and controlled or structural fills, while the alternative is to direct them to *dry* or *wet storage areas*. Although many *CCPs* were placed in storage due to not meeting applicable specifications for use, many other *CCPs* were stored for lack of market. In either case, the *CCPs* retain the ability to be considered a wanted material that provides a functional benefit and a benefit to the environment. They can be harvested and lightly processed, if necessary, to meet relevant product specifications and substitute for the raw materials. Depending on the type and homogeneity of *CCPs* and the type of *storage area* from which the materials are being harvested (that is, *dry* or *wet storage areas*), this *harvesting* and *processing* may include, but is not limited to, excavating or dewatering/dredging, drying, milling, classifying and storing or transporting the material before they are beneficially used.

1.6 The *CCPs* that may be harvested include: *fly ash*, *bottom ash* and *economizer ash* generated by powdered carbon boilers; *boiler slag*; *flue gas desulfurization material*; *fluidized-bed combustion* products as defined in Terminology E2201; *cenospheres*; or other materials suitable for beneficial use.

1.7 Laws and approval requirements governing the use of *CCPs* vary by locality, ~~state and country~~ state, and country, and generally do not yet include provisions for *CCP harvesting* as described herein. The user of this guide is responsible for determining and complying with the applicable approval requirements, which may extend beyond *harvesting* to include approval requirements or guidance on issues such as storage, transportation, end use, and other concepts. This guide complements approval programs where guidance on *harvesting* is unavailable or insufficient, thereby improving the chance that such *storage areas* may be repurposed for public or private benefit, or both. It is important to engage and educate the *approval authority* early and often throughout the planning, design, and implementation of the *harvesting* activities. The *project team* may also consider affording an opportunity to solicit input from other *stakeholders*.

1.8 This guide should not be used as a justification to avoid, minimize, or delay implementation of specific management, operation, *closure*, or remediation activities, or both as appropriate by law or directive, unless the *harvesting* activities are conducted in conjunction with such strategies to maintain or achieve compliance with the approval requirements or as otherwise agreed upon with the appropriate authorizing agencies.

1.9 This guide should not be used to characterize (that is, environmentally assess) a *storage area* for ownership transfer although portions of such information may supplement other environmental assessments that are used in such a transfer.

1.10 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.11 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

[C311 Test Methods for Sampling and Testing Coal Ash or Natural Pozzolans for Use in Concrete](#)

[C618 Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete](#)

[D653 Terminology Relating to Soil, Rock, and Contained Fluids](#)

[E1527 Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process](#)

[E2201 Terminology for Coal Combustion Products](#)

[E2277 Guide for Design and Construction of Coal Ash Structural Fills](#)

### 2.2 EPA Standards:<sup>3</sup>

[40 CFR 260.10 Hazardous Waste Management System: General – Definitions](#)

[40 CFR 312.10 Innocent Landowners, Standards for Conducting All Appropriate Inquiries – Definitions](#)

## 3. Terminology

3.1 For additional definitions related to *coal combustion products (CCPs)*, see Terminology [E2201](#). For definitions related to geotechnical properties, see Terminology [D653](#).

### 3.2 Definitions:

3.2.1 *active facility*, *n*—a facility producing electricity.

3.2.2 *active storage area; area(s)*, *n*—~~a storage area~~*area(s) that has had containing CCPs placed within it, but that has not completed closure* in accordance with the *approval authority* requirements.

3.2.3 *approval authority*, *n*—~~an authority entity that is tasked to ensure authorized to establish and enforce compliance with environmental protection and public/worker safety laws and directives concerning the management of CCP storage areas~~*area(s); this includes governments of cities, counties, states, countries, provinces, and tribal organizations.*

3.2.4 *beneficial use of coal combustion products (CCPs)*, *n*—~~the use of or substitution of the recycling coal combustion products (CCPs) for another product based on performance criteria. The CCPs will be used in a manner that meets the design specification; conserves natural resources and energy; reduces greenhouse gas emissions, and/or protects human health and the environment; along with other benefits. For purposes of this definition, beneficial use includes, but is not limited to, raw feed for cement clinker; concrete, grout, flowable fill, controlled low strength material; controlled or structural fill; road base/sub-base; soil modification; mineral filler; snow and ice traction control; blasting grit and abrasives; roofing granules; mining applications; wallboard; waste stabilization/solidification; soil amendment; and agriculture. in lieu of disposal.~~

#### 3.2.4.1 Discussion—

~~See Terminology~~The beneficial [E2201](#) use of *CCPs*, for more information, when appropriate, may result in the conservation of natural resources and energy and the reduction of greenhouse gas emissions while protecting human health and the environment. For the purpose of this guide, beneficial use includes, but is not limited to: raw feed for cement clinker, concrete, grout, flowable fill, and controlled low-strength material; controlled or structural fill; road base/sub-base; soil modification; mineral filler; snow and ice traction control; blasting grit and abrasives; roofing granules; mining applications; gypsum panel; waste stabilization/solidification; soil amendment; and agriculture.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from United States Environmental Protection Agency (EPA), William Jefferson Clinton Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20460, <http://www.epa.gov>.

3.2.5 *boiler slag*, *n*—a molten ash collected at the base of slag tap and cyclone boilers that is quenched with water and shattered into black, angular particles having a smooth, glassy appearance.

3.2.6 *bottom ash*, *n*—~~agglomerated ash particles formed in pulverized coal boilers that are too large to be carried in the flue gases and impinge on the boiler walls or fall through open grates to an ash hopper at the bottom of the boiler.~~ ash that results from the process of combustion of ground or powdered coal that is not transported by flue gases.

3.2.6.1 *Discussion*—

See Terminology **E2201** for more information.

3.2.7 *caps or cover*, *n*—natural (for example, engineered soil *liners* or *caps*) or synthetic (for example, linear low-density polyethylene, LLDPE) materials placed on the top of a *storage area* to minimize the infiltration of rainwater into the *storage area*.

3.2.8 *cenospheres*, *n*—~~lightweight, inert, hollow spheres made largely of silica and alumina and filled with air or inert gas, typically produced as a byproduct of coal combustion at power plants.~~ type of fly ash particle consisting of lightweight, hollow sphere.

3.2.9 *closure*, *n*—for *permitted storage areas*, *closure* of a *storage area* is completed by either meeting *harvesting* goals and project endpoints or installing a *cap/cover*, as appropriate, ~~per~~ in accordance with the approval authority.

3.2.10 *coal ash*, *n*—a collective term referring to any solid materials produced primarily from the process of combustion of coal (for example, *fly ash*, *bottom ash*, or *boiler slag*).

3.2.11 *coal combustion products (CCPs)*, *n*—~~fly ash, solid materials, bottom ash, that boiler slag, result fluidized-bed combustion (FBC) ash, or flue gas desulfurization (FGD) material produced primarily from the process of combustion of coal or the cleaning of the stack gases.~~ ground or powdered coal.

3.2.11.1 *Discussion*—

Examples of coal combustion products include *fly ash*, *bottom ash*, *flue gas desulfurization (FGD) residue*, and *boiler slag*. This definition of coal combustion products does not include, among other things, the residue resulting from: (1) fluidized bed combustion, (2) the burning of municipal solid waste or any other refuse with coal, or (3) the burning of industrial or municipal solid waste in incinerators.

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<https://standards.iteh.ai/catalog/standards/astm/371ac759-b3bc-40f8-a188-ccc5894bf3bc/astm-e3183-24>

3.2.12 *contact water*, *n*—the liquid byproduct of *CCP* placement or *harvesting* within the *active* or *inactive storage area* whose origin may be the *CCPs* combined with rainwater that runs off the *CCPs* and does not infiltrate the *CCPs*.

3.2.13 *dry CCPs*, *n*—*CCPs* placed in a *dry storage area* not containing free liquids.

3.2.14 *dry CCP storage area*, *area(s)*, *n*—~~the location where~~ area of land ~~dry CCPs are stored; a dry stack, valley fill, landfill, storage unit or cell, which is designed to hold an accumulation of or excavation used to manage and store coal combustion products that is not a~~ *CCPs* wet and *CCP leachate*. ~~*storage area*.~~

3.2.15 *economizer ash*, *n*—*coal ash* that exits the combustion chamber carried in the flue gases used by the economizer, which is typically captured by hoppers. ~~Economizer ash is heavier/coarser than fly ash, but lighter/less coarse than bottom ash.~~

3.2.15.1 *Discussion*—

*Economizer ash* is heavier and coarser than *fly ash*, but lighter and less coarse than *bottom ash*.

3.2.16 *engineering controls*, *n*—constructed containment barriers or systems that control the downward migration, infiltration or seepage or surface runoff and rain; control the natural leaching/migration of containments through the subsurface over time; control fugitive emissions; and measures that minimize the flow of liquids and fugitive emissions into or out of a regulated *storage area* *area(s)*. (for example, engineered soil *liners* or *caps*, *leachate* collection and removal systems, dewatering systems, and surface water management systems).

3.2.16.1 *Discussion*—

Examples of engineering controls are engineered soil *liners* or *caps*, *leachate* collection and removal systems, dewatering systems, surface water management systems, and dust control systems.

3.2.17 *environmental professional, n*—a person trained and experienced in the management of materials and *storage areas*area(s); he or she has the credentials to make professional judgments about the acceptability of how land is used, potential impacts to safety, human health and the environment, and the effectiveness of engineering, institutional and regulatory controls.

3.2.17.1 *Discussion*—

An *environmental professional* has the credentials to make professional judgments about the acceptability of how land is used; potential impacts to safety, human health, and the environment; and the effectiveness of *engineering, institutional and regulatory controls*. The definition of environmental professional in this guide is different and mutually exclusive from the definition of environmental professional as defined in the Environmental Protection Agency’s (EPA’s) All Appropriate Inquiries rule (40 CFR 312.10) and Practice E1527.

3.2.18 *facility, n*—~~all contiguous land and structures associated with the power plant, as used in this guide, a coal-fired power plant including all contiguous land, structures, other appurtenances, and improvements on the land, land used for treating, storing, disposing, or otherwise conducting solid waste management of CCPs. A facility may consist of several treatment, storage, or disposal operational units (for example, one or more active or inactive storage areas).~~

3.2.18.1 *Discussion*—

A *facility* may consist of several treatment, storage, or disposal operational units (for example, one or more *active* or *inactive storage area(s)*). A *facility* as defined in this guide is not necessarily a permitted Resource Conservation and Recovery Act (RCRA) treatment, storage, or disposal facility as defined in 40 CFR 260.10.

3.2.19 *flue gas desulfurization (FGD), n*—removal of gaseous sulfur dioxide from boiler exhaust gas.

3.2.19.1 *Discussion*—

See Terminology E2201 for more information.

3.2.20 *flue gas desulfurization (FGD) material, n*—a product of an *FGD* process typically using a high-calcium sorbent such as lime or limestone.

3.2.20.1 *Discussion*—

See Terminology E2201 for more information.

3.2.21 *fluidized-bed combustion (FBC) ash, n*—the *fly ash* and bed ash produced by an FBC boiler.

3.2.22 *fly ash, n*—~~coal ash finely divided that exits a combustion chamber in the flue gas and is captured by air pollution control equipment such as electrostatic precipitators, baghouses, and wet scrubbers. residue that results from the process of combustion of ground or powdered coal and is transported by flue gases.~~

3.2.22.1 *Discussion*—

This definition of *fly ash* does not include, among other things, the residue resulting from: (1) *fluidized bed combustion*, (2) the burning of municipal solid waste or any other refuse with coal, or (3) the burning of industrial or municipal solid waste in incinerators.

3.2.23 *harvesting, v*—the removal, or reclamation, of *CCPs* from an *active* or *inactive storage area*area(s) for the purpose of beneficial use.

3.2.24 *harvesting phase, n*—a segment of the overall *storage area harvesting* that strategically divides the *harvesting* area based on the anticipated sequence of *harvesting* within the *storage area*, while considering issues such as site access, *harvesting* rate, management of liquids during *harvesting*, and end use.

3.2.25 *harvesting sub-phase, n*—a subdivision of a *harvesting phase* that provides further detail on *harvesting* activities including proposed grades; management of *leachate*, *contact water* and surface water; placement of cover; and removal/addition of infrastructure as *harvesting* progresses.

3.2.26 *historic CCP fill material, n*—*CCPs* typically that were placed before effective regulatory requirement governed material placement, and therefore, they were stored without a permit or an approval obtained by an *approval authority*.

3.2.27 *historic (or unpermitted) storage area, n*—the location where *historic CCPs* were placed before effective environmental regulatory requirements governed material placement.



3.2.28 *inactive facility*, *n*—a facility not producing electricity.

3.2.29 *inactive storage area*, *n*—~~a storage area~~*area(s)* ~~that has had containing CCPs placed within it and that has completed closure in accordance with the approval authority requirements, requirements or has not placed CCPs within a period specified by the approval authority (as applicable).~~

3.2.30 *institutional controls*, *n*—~~administrative measures (of measures established and enforced by an approval authority) that guide users and owners directs users of CCP storage areas~~*area(s)* on appropriate or prohibited activities, and deliverable documents concerning the control of *leachate*, stormwater runoff and water infiltration. ~~These conditions may include what is allowed, what is to be measured during inspections, and what is to be done if conditions exceed what is considered acceptable. The environmental professional may recommend such controls in their evaluation of a site using this guide, in addition to what an approval authority requires.~~

3.2.30.1 Discussion—

These measures may include what activities are allowed or permitted, what is to be measured during inspections, and required responses or corrective action are to be implemented if conditions exceed what is considered acceptable.

3.2.31 *leachate*, *n*—the liquid byproduct of placement within an *active* or *inactive storage area* whose origin may be of the following sources: (1) the *CCP* material itself; (2) the *CCP* material combined with rainwater that infiltrates the *CCP* material; or (3) the *CCP* material dissolved in groundwater that has infiltrated the *storage area* (typically at the base of a pre-approval *storage area*).

3.2.32 *liners*, *n*—natural (for example, engineered soil *liners*) or synthetic (for example, high density polyethylene, HDPE) materials placed on the bottom and sidewalls of a *storage area* to contain *leachate* and prevent or minimize the infiltration of *leachate* to groundwater.

3.2.33 *permitted storage area*, *n*—~~storage area~~*area(s)* where the placement of *CCPs* was governed by approval from an *approval authority* (that is, governing documents regulate the construction, operations, and *closure* of the *storage area**area(s)*).

3.2.34 *post-closure care measures*, *n*—activities that the *CCP storage area* owner must take to maintain the effectiveness of *engineering and institutional controls* that protect against potential adverse impacts to human health, public safety, and welfare; applies to a *storage area* under the authority of an *approval authority*. <sup>24</sup>

<https://standards.iteh.ai/catalog/standards/astm/371ac759-b3bc-40f8-a188-cce5894bf3bc/astm-e3183-24>

3.2.35 *processing*, *v*—~~activities through which that the CCP undergoes, such as, dewatering, dredging, drying, and/or drying or milling of CCPs, prior to storage and/or transportation or both, before storage or transportation or both of the materials to end use.~~

3.2.36 *project team*, *n*—two or more professionals (including the *environmental professional*) who collaborate on the evaluation and selection of a *CCP storage area**area(s)* to be harvested. ~~The team may include the user; environmental professionals; the local, state and country approval authority; ash management/marketing partner; and the storage area owner and/or his or her representatives. For some storage areas, the project team may also include community stakeholders.~~

3.2.36.1 Discussion—

The team may include the user; *environmental professionals*; the local, state, and country *approval authority*; ash management/marketing partner; and the *storage area(s)* owner or his or her representatives. For some *storage area(s)*, the *project team* may also include *community stakeholders*.

3.2.37 *run-off*, *n*—any rainwater, *leachate*, or other liquid that drains over land from any part of a *CCP storage area*.

3.2.38 *run-on*, *n*—any rainwater, *leachate* or other liquid that drains over land onto any part of the *CCP storage area*.

3.2.39 *stakeholders*, *n*—a person with an interest in the outcome of a decision to harvest *CCPs* from the *storage area*; includes the property owner, energy producers, neighboring property owners, community representatives, development and conservation groups, sustainability advocates, and other interested parties.

3.2.40 *storage area*, *n*—an area where *wet CCPs* ((see *wet storage area**area(s)*)) or *dry CCPs* ((see *dry storage area**area(s)*)) are stored within a *facility*.

3.2.41 *storage area closure, n*—the transition period of a regulated *storage area* between the *active* receipt of *CCPs* and the start of the *post-closure* care period; often involves the installation of the *storage area cap* that isolates the *CCPs*. *Historic storage areas* may not be able to achieve “*closure*”.

3.2.42 *storage area post-closure care period, n*—following *closure of storage area*, a span of time in which the *storage area* may need to be inspected ~~and/or monitored~~ or monitored, or both, in accordance with requirements determined by the *approval authority* (as applicable).

3.2.43 *unpermitted storage area, n*—~~*storage area*~~ *area(s)* where the placement of *CCPs* was not governed by approval from an *approval authority*. ~~(that is, a historic storage area where governing documents do not regulate the construction, operations and closure of the storage area).~~

3.2.43.1 Discussion—

Current governing requirements that regulate construction, operations, and closure of the *storage area(s)* are not applicable to *unpermitted storage area(s)*.

3.2.44 *wet CCPs, n*—*CCPs* that were hydraulically placed in a ~~*storage area*~~ *area(s)*.

3.2.45 ~~*wet storage area*~~ *area(s), n*—~~the location where wet CCPs are stored;~~ a topographic depression, man-made excavation, impoundment, or diked area, which is designed to hold an accumulation of *CCPs* and liquids.

3.2.45.1 Discussion—

*Wet storage area(s)* contain *wet CCPs*.

#### 4. Significance and Use

4.1 *Purpose*—This guide provides a process for reclamation of existing *CCPs* placed in *active* and *inactive storage areas*. The guide includes information on the following activities required for the safe and effective reclamation of *CCPs* from *storage areas*: (1) Background Review of *CCP Storage Areas*; (2) Detailed Characterization of *CCP Storage Areas*; (3) *Harvesting* Planning and Scoping of *CCP Storage Areas*; (4) *Harvesting* Detailed Design and Approval of *CCP Storage Areas*; and (5) *Harvesting* Implementation of *CCP Storage Areas*. More detailed descriptions of these activities are in Sections 6 through 10.

4.2 *Potential Beneficial Uses of CCPs*—There are many *CCP storage areas* that are potentially harvestable and can provide a functional benefit in a wide variety of beneficial uses. The *beneficial use of CCPs* contained in these *storage areas* can have significant environmental and economic benefits for the *facility*, the *facility* owner and the local economy, and can significantly reduce disposal operations (1-4).<sup>4</sup> *Beneficial use of CCPs* can provide industry with a safe and responsible way to economically manage the *CCPs*, while promoting conservation and recycling/reuse, meeting sustainability goals, and addressing the shortage of *CCPs* in some building product market areas (1, 2, 5). *CCPs* consist of *fly ash*, *bottom ash*, *boiler slag*, *fluidized-bed combustion (FBC) ash*, *economizer ash*, and *flue gas desulfurization (FGD) material* (see Terminology E2201 for definitions of *CCPs*) (6, 7).

4.2.1 *Fly ash* is the most abundant *CCP* in existing *storage areas*. Its beneficial uses include, but are not limited to: partial replacement for cement in concrete and concrete products – once in concrete, *fly ash* reacts with Portland cement to create additional reaction products that improve the strength and durability of concrete; raw feed for the production clinker – *fly ash* can be calcined along with other minerals to produce clinker; blended cements – *fly ash* can be an important component in the production of blended cement, especially when pozzolanic properties are desired; filler in plastics – *fly ash* typically increases the stiffness and compressive strength when used as a filler in plastics; controlled low strength materials (CLSM) – CLSM that include *fly ash*, typically have improved flowability and strength as well as reduced bleeding and shrinkage; as a soil stabilization material; as an aggregate/soil replacement construction material in structural fill and mine reclamation projects; fillers in carpet backing – *fly ash* is high performance mineral filler; and as a solidification agent within landfills and remediation projects (6-9).

4.2.2 *Bottom ash* can be beneficially used as raw feed for the production of clinker, as a component of structural fills, and as aggregate in the manufacturing of masonry products (6, 7, 9).

4.2.3 *Boiler slag* can be used as blasting grits and roofing granules. Other applications include, but are not limited to, as a component of structural fills and mineral filler in asphalt (7, 9).

<sup>4</sup> The boldface numbers in parentheses refer to the list of references at the end of this standard.

4.2.4 *Fluidized-bed combustion (FBC) ash* can be utilized in various mixtures as a ~~low-strength~~ low-strength concrete material and soil stabilization agent (7).

4.2.5 *Flue gas desulfurization (FGD) gypsum*, in its majority, is typically beneficially used in gypsum panel products. Other uses include in agricultural applications to improve soil, as a component in structural fills, and as an important component in the production of cement (6, 7, 9).

4.3 *Approval Context*—This guide does not supersede local, state or country requirements, if applicable. This guide is intended to be used for *storage areas* that are both within an *approval authority* program and *historic (or unpermitted) storage areas*.

4.3.1 For *harvesting* of *CCPs* from *storage areas* within an *approval authority* program, governing documents should be carefully reviewed and followed to ensure that all requirements relative to design, operations, monitoring, *closure*, and *post-closure* are followed, or that agreements are established to ensure compliance and allow for *harvesting* activities.

4.3.2 For *harvesting* of *CCPs* from *historic (or unpermitted) storage areas*, the *project team* should engage with the appropriate local, state, province, or country approval, or combination thereof, authorities to determine the appropriate requirements, and should ensure that the appropriate *engineering controls* and *institutional controls* are incorporated into the *harvesting* project.

4.4 *Use of Guide*—Approval authorities may incorporate this guide, in whole or in part, into general guidance documents or site-specific approval documents.

4.5 *Professional Judgment*—This guide presumes the active involvement of an *environmental professional* who is knowledgeable in how to design and construct *storage areas* and how to identify acceptable site conditions, or when appropriate, satisfy applicable statutory or *approval authority* limitations on the use of an operating, closed, or *historic (unpermitted) storage area*.

4.6 *Inherent Uncertainty*—Professional judgment, ~~interpretation, interpretation,~~ interpretation, and some uncertainty are inherent in the processes described herein even when decisions are based upon objective scientific principles and accepted industry practices.

## 5. Project Planning and Scoping

5.1 Prior to applying this guide, the user should perform the following project planning and scoping activities: (a) identify an *environmental professional* to assist with the technical components of the project; (b) develop a *project team*; (c) identify site and *storage areas* to be potentially harvested; (d) determine the potential beneficial uses of the *CCPs*; and (e) compile site data.

5.1.1 The user should identify an *environmental professional*, who for purposes of this guide, is a person who possesses sufficient education, training, experience and certifications (as applicable), and exercises sound professional judgment regarding the components of this guide.

5.1.2 The user should assemble a *project team* that considers attributes such as historical site knowledge; technical expertise relevant to the components of this guide including the investigation, assessment, design, approval process (as applicable), construction, operation, monitoring, and maintenance of *active/inactive storage areas* that are protective to human health, public safety, and welfare; *approval authority* requirements; and *stakeholder* interests and concerns, if known.

5.1.3 Prior to using this guide, the user should determine which *storage areas* could provide useful *CCPs* for beneficial use and should be evaluated for potential *harvesting*. This guide is to be used to evaluate the potential *harvesting* of *storage areas* once the *storage areas* are selected for evaluation.

5.1.4 The user may prepare an initial determination of the potential uses of the *CCPs* from the available *storage areas* at the *facility*. These may be refined following completion of the Site Background Review and Detailed Characterization of *CCP Storage Areas* tasks (see Sections 6 and 7, respectively).

5.1.5 The user should compile land use, historic environmental compliance, geologic and hydrogeologic, topographic, design and construction-related information (if available); estimate project costs and develop the project schedule with contingencies (if feasible); and identify other factors that may impact the ability to harvest the *CCPs*.



5.2 When an *approval authority* program governs *harvesting* of *CCPs*, the user should evaluate whether the applicable *approval authority* program and the goals and requirements of this guide complement each other and are protective to human health, public safety, and welfare.

5.3 *Process*—The five phases of the *Harvesting Coal Combustion Products Stored in Active and Inactive Storage Areas* guide are presented on **Table 1**. Detailed information on the five phases are presented on **Figs. 1-5** and in Sections **6** through **10**.

## 6. Background Review of CCP Storage Areas, Phase I (see **Fig. 1**)

6.1 A Background Review of the *CCP Storage Areas* should be initiated after the Project Planning and Scoping activities are completed (see Section **5**), including identification of an *environmental professional* and *project team*, determination of which *storage areas* should be evaluated for potential *harvesting*, initial determination of potential beneficial uses of *CCPs*, and compilation of relevant *storage area* information (see **5.1.5**).

6.2 *Site Background Review of CCP Storage Areas Steps*—The Site Background Review of *CCP Storage Areas* process follows the following three steps: Step 1 – Determine the *Approval Authority* Applicability of *Storage Areas*; Step 2 – Determine if *Harvesting CCPs* Will Meet End Use Criteria; Step 3 – Establish Baseline Conditions of *CCP Storage Areas*. The three steps are summarized below and shown on **Fig. 1**.

6.2.1 *Step 1: Determine the Approval Authority Applicability of Storage Areas*—A review of local, state, country, and province requirements should be completed to determine *approval authority* and compliance criteria that may be applicable. Such criteria may apply to both the *harvesting* of the *CCPs*, as well as the actual beneficial use of the *CCPs* or other issues.

6.2.1.1 Permitted facilities may have specific approval and compliance criteria stated in the operational, *closure* or *post-closure* documents, or both, and other *approval authority* criteria may exist outside of applicable permits that may apply to *harvesting*.

6.2.1.2 Unpermitted facilities may use general standard operating procedures, existing requirements for permitted facilities or other arbitrary guidelines, or both that may apply to *harvesting*.

6.2.2 *Step 2: Determine if Harvesting CCPs Will Meet End Use Criteria*—A general review of the potential end use specifications, technologies and performance standards should be completed. In their absence, development of new specifications or changes to existing standards should be considered. If *CCPs* do not meet current end use specifications and performance standards for a specific application, consider what amendments or *processing* could be made to the raw *CCPs* to meet the end use specifications and performance standards, or whether changes to the specifications and standards could be made to allow *harvesting* of *CCPs* to be feasible, or both.

6.2.2.1 Review existing chemical, physical and geotechnical information for the *CCPs* relative to the requirements of the intended end use.

6.2.2.2 Review estimated volume of *CCPs* that may be obtained during *harvesting* activities to assess feasibility of project.

6.2.2.3 Review transportation considerations and distance between the source and the end use.

6.2.3 *Step 3: Establish Baseline Conditions of CCP Storage Areas*—A review of available data related to the *CCP storage areas*' attributes should be completed to establish baseline conditions. Such attributes include, but are not limited to: *facility* layout and infrastructure; *storage area* configuration, design, and fill sequencing/phasing; types, homogeneity, age, liquid content,

**TABLE 1 Harvesting Phase Information**

NOTE 1—Process assumes the *storage areas* have already been chosen. Site selection is not included in this Guide.

Phases	Description	Location within this guide
I	Site Background Review of CCP Storage Areas	<b>Fig. 1</b> and Section <b>6</b>
II	Detailed Characterization of CCP Storage Areas	<b>Fig. 2</b> and Section <b>7</b>
III	Harvesting Planning and Scoping of CCP Storage Areas	<b>Fig. 3</b> and Section <b>8</b>
IV	Harvesting Detailed Design and Approval (if required) of CCP Storage Areas	<b>Fig. 4</b> and Section <b>9</b>
V	Harvesting Implementation of CCP Storage Areas	<b>Fig. 5</b> and Section <b>10</b>

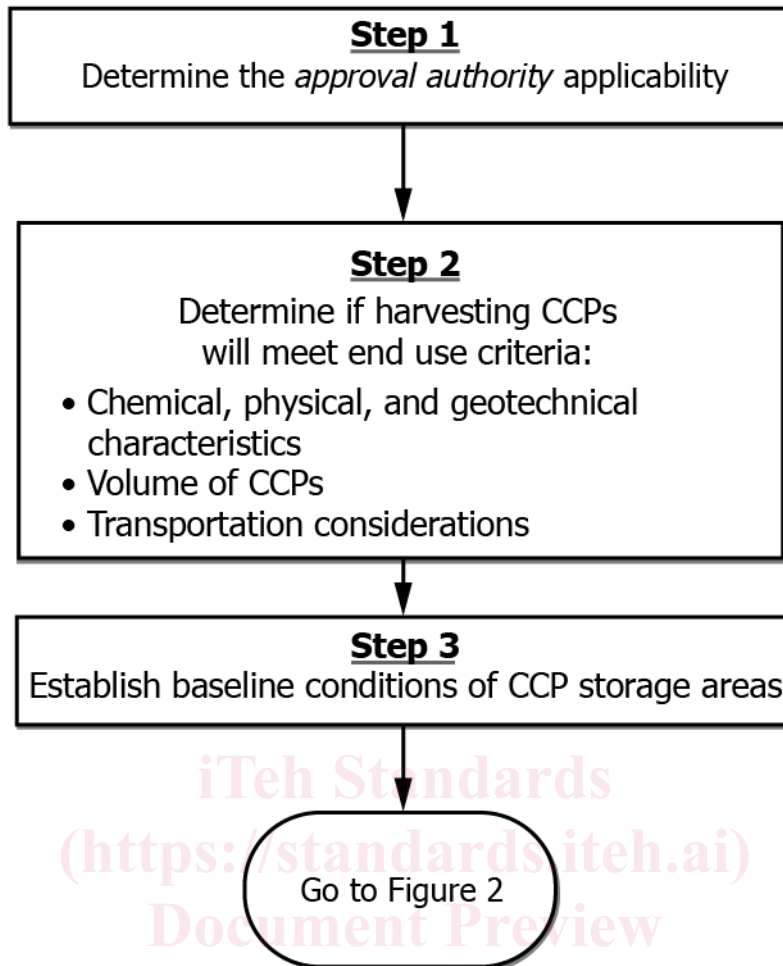


FIG. 1 Phase I – Site Background Review of CCP Storage Areas

physical/chemical characteristics, and volume of CCPs; geologic, hydrogeologic and hydrologic conditions; and roadways/transportation hubs and surrounding environs.

## 7. Detailed Characterization of CCP Storage Areas, Phase II (see Fig. 2)

7.1 A Detailed Characterization of *CCP Storage Areas* should be initiated after completion of the Site Background Review of *CCP Storage Areas*, including the determination of the applicability of *approval authority* involvement, feasibility of the *harvesting* of the *CCP storage areas*, and establishing baseline conditions for management of the *harvesting* unit.

7.2 *Detailed Characterization of CCP Storage Areas Steps*—The Detailed Characterization of *CCP Storage Areas* process follows the following five steps: Step 1 – Develop *CCP* Characterization Sampling and Analysis Plan; Step 2 – Perform Appropriate *CCP* Sampling; Step 3 – Perform Appropriate Laboratory Analyses; Step 4 – Evaluate Results of Characterization; Step 5 – Determine Suitability of *CCPs* for *Harvesting*. The five steps are summarized below and shown on Fig. 2.

7.2.1 *Step 1: Develop CCP Characterization Sampling and Analysis Plan*—A *CCP* Characterization Sampling and Analysis Plan should be prepared to augment the baseline information.

7.2.1.1 The plan should establish the data quality objectives and sampling protocols needed to obtain adequate datasets appropriate to maintain approval compliance and meet end use specifications and performance standards. A description of the assessment of the representativeness of the samples or a pre-determined level of uncertainty, or both, determined to be acceptable for the project needs to be included.

7.2.1.2 The number of samples to be collected, sample locations, and sample volumes for the applicable test methods should be included. The plan should establish methods for collecting representative samples and should establish mineralogical, geochemical,