COMBUSTION TURBINE TECHNOLOGIES

LISTING OF DIVERSE ENGINEERING & DESIGN EXPERIENCE WITH COMBINED-CYCLE, COGENERATION, AND SIMPLE-CYCLE PROJECTS

Sargent & Lundy LLC

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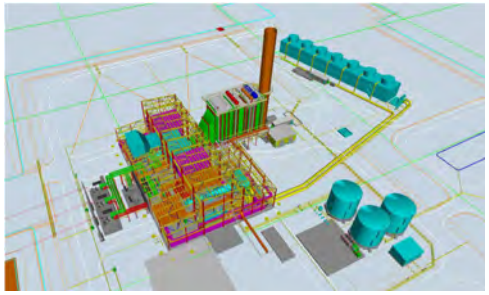
COMBINED-CYCLE AND COGENERATION PROJECTS

Wildcat Point Generation Facility

Client	Old Dominion Elec. Coop.
Location	Rising Sun, MD
Plant Type	CC
Fuel	Natural gas
Size	1000 MW
COD	2017
CT Supplier	MHI 501GAC (2)
Configuration	2x1

ODEC awarded the Wildcat Point Generation Facility engineering, procurement, and construction (EPC) project to White Oak Power Constructors (WOPC), the Joint Venture (JV) of S&L and PCL Industrial Construction Company. S&L has responsibility for all detailed design, engineered equipment procurement, commissioning and joint venture executive management. Major equipment purchased by ODEC and assigned to the EPC JV includes two MHI 501GAC CTs, two Alstom HRSGs, Alstom STG, and SMIT GSUs. The project is on an existing operating site with 4 CTs in Cecil County, Maryland, adjacent to the Pennsylvania state border.



Carty

Client	Abeinsa/Abengoa
Location	Portland, OR
Plant Type	CC
Fuel	Natural gas
Size	440 MW
COD	Mid-2016
CT Supplier	MHI 501GAC
Configuration	1x1x1

Abeinsa is leading EPC efforts to complete project and S&L is providing complete engineering design in support of Abiensa's EPC contract obligations, including BOP and engineered equipment specifications. The major components (MHI 501GAC CT, SRT-50 single-casing reheat STG, and Nooter/Eriksen triple-pressure reheat-fired HRSG) are supplied by Mitsubishi Power Systems Americas, Inc. (MPSA). Other major features in design are auxiliary boiler, SCR and CO_2 control systems, condenser, mechanical-draft cooling tower, electrical and I&C systems, DCS, water supply and treatment system, wastewater system, and fire protection system. Provisions made for additional unit of equal size.

Ras Al-Khair CC and SC Power and Desalination Plant

Client	SEPCOIII
Location	Saudi Arabia
Plant Type	CC/SC and desalination
Fuel	Natural gas
Size	2400 MW
COD	CC: 2014 / SC: 2013
CT Supplier	Siemens SGT6-5000
Configuration	5 CC blocks, 2x2x1 1 SC block

EPC Contractor's Engineer scope covers BOP engineering and design; procurement specifications, with purchasing support; detailed vendor drawing reviews; and management support for equipment, material delivery, and construction, as requested. S&L was challenged with confirming and finishing detailed engineering started by others, and integrating equipment purchases, including all mechanical and electrical interconnecting design by others. All engineering accelerated due to multiple contract participant changes.

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COMBINED-CYCLE AND COGENERATION PROJECTS

Qurayyah IPP 1-6

Client	Samsung C&T
Location	Saudi Arabia
Plant Type	CC
Fuel	Natural gas/diesel oil
Size	4000 MW
COD	2015
CT Supplier	SGT6-PAC 5000F
Configuration	6 blocks, 2x2x1

Detailed design of power block and BOP facilities. Preparation of technical specifications to purchase equipment and commodities; system studies and calculations; P&IDs, flow diagrams, schematics, equipment location general arrangements, and 3-D model; equipment, valve, and cable lists; and as-builts.

GMR (S) Energy

Client	Samsung C&T
Location	Singapore
Plant Type	CC
Fuel	Gas/diesel 2
Size	2x400
COD	2013
CT Supplier	SGT5-4000F
Configuration	2 blocks, 1x1x1

Mechanical BOP engineering, design, and specifications.

Deer Creek 1

Client	Basin Electric Power Coop.
Location	Brookings County, SD
Plant Type	CC
Fuel	Gas
Size	300 MW
COD	2012
CT Supplier	GE 7FA
Configuration	1x1x1

Preliminary engineering, permitting support, air model and permit work, major equipment and BOP procurement, detailed plant design, and preparation of construction GWC specification and project integrated master schedule. Key milestones: Project award May, 2008; GWC award January, 2010; PSD permits April, 2010, ground-breaking September, 2010; and COD August 1, 2012. Project funding by Rural Utilities Service (RUS), a division of the U.S. Department of Agriculture. At the time, the first CC plant with the CT and ST enclosed indoors. At the station dedication ceremony on August 16, 2012, Basin Electric's project manager stated that the project "was done on time, under budget, and safely."

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COMBINED-CYCLE AND COGENERATION PROJECTS

Edwardsport IGCC

Client	Duke Energy
Location	Edwardsport, IN
Plant Type	IGCC
Fuel	Gas
Size	630 MW
COD	2013
CT Supplier	GE 7FB
Configuration	2x2x1

BOP engineering and design: raw water collection, treatment, and storage systems; grey water disposal system; coal handling system; potable water supply; auxiliary power supply and distribution system; various underground piping and electrical infrastructure; fire protection systems; auxiliary fuel delivery; storm water drainage and collection, oil water collection and separation systems; DCS interface and uninterruptible power supply system.

Qurayyah 1-15 (SC) and 1-5 (CC)

Client	Arabian Bemco
Location	Saudi Arabia
Plant Type	SC and CC
Fuel	Gas and oil
Size	1,900 MW total
COD	2007-2012
CT Supplier	GE7FA (Units 1-15)
Configuration	(5) 3x3x1

Phase 1: Detailed design of power block and BOP SC facilities. Preparation of: ERPs to purchase the necessary plant equipment; BOQs to purchase bulk commodity materials; system studies and calculations; P&IDs, flow diagrams, and schematic diagrams; control logic and system descriptions; equipment location and GA drawings; equipment, valve, and cable lists; construction drawings and installation details, civil and structural works; steam and BOP piping; wiring and cable design; as-built drawings; and O&M manuals.

Phase 2: 5 CC units with each block of 3 GTs converted to 3x1 CC arrangement, increasing nominal power output to 3040-3210 MW.

Dresden

Client	AEP
Location	Muskingum, OH
Plant Type	CC
Fuel	Gas and oil
Size	500 MW
COD	2012
CT Supplier	GE 7FA
Configuration	2x2x1

Complete engineering and design, including preparation of equipment specifications, procurement services, and significant input into the project integrated schedule.

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COMBINED-CYCLE AND COGENERATION PROJECTS

Surgutskaya 1,2

Client	Gama Power Systems
Location	Surgut City, Russia
Plant Type	CC
Fuel	Natural gas
Size	800 MW total
COD	2011
CT Supplier	GE 109FA
Configuration	(2) 1x1x1

Detailed engineering and design services for EPC project, including preparation of all equipment specifications, procurement services, and the development of the integrated project engineering / construction / procurement schedule.

Shaturskaya

Client	Gama Power Systems
Location	Shatura, Russia
Plant Type	CC
Fuel	Natural gas
Size	400 MW
COD	2010
CT Supplier	GE 109FA
Configuration	1x1x1

Detailed engineering and design services for EPC project, including preparation of all equipment specifications, procurement services, and the development of the integrated project engineering / construction / procurement schedule.

J. L. Stall

Client	AEP
Location	Shreveport, LA
Plant Type	CC
Fuel	Gas
Size	540 MW
COD	2010
CT Supplier	SWPC 501FD2
Configuration	2x2x1

Detailed design and engineering services, including preparation of specifications and drawings for the EPC construction, erection, commissioning and startup; procurement and expediting of process equipment; and field engineering services on behalf of S&L and TIC JV. Project awarded the Associated Builders and Contractors (ABC) South Texas Chapter's top honor in mega-project category in its annual Excellence in Construction competition. Award based on overcoming obstacles in project completion, innovative quality control and scheduling, and site safety record and safety programs.

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COMBINED-CYCLE AND COGENERATION PROJECTS

Hillabee

Client	Constellation Energy (Exelon)
Location	Alexander City, AL
Plant Type	CC
Fuel	Natural gas
Size	700 MW
COD	2009
CT Supplier	SWPC 501G
Configuration	2x2x1

Detailed design, permitting support, site development, civil design, design criteria, piping and instrumentation diagrams, piping installation drawings, power and control cabling, steel and foundations, procurement support, interface with installation contractor, and construction / startup support. Construction was postponed in 2003. In 2008, Constellation, the new owner, authorized S&L to restart the engineering effort, with commercial operation achieved in 2009.

Riverside

Client	Xcel Energy
Location	Minneapolis, Minnesota
Plant Type	CC repowering
Fuel	Gas
Size	480 MW
COD	2009
CT Supplier	GE 7FA
Configuration	2x2x1

Detailed engineering, design, and procurement services for repowering of two coal-fired boilers using new gas-fired combined-cycle Units 9 and 10.

Hopkins Repowering

Client	City of Tallahassee
Location	Tallahassee, FL
Plant Type	CC
Fuel	Gas and oil
Size	300 MW
COD	2008
CT Supplier	GE 7FA
Configuration	1x1x1

Initial studies of repowering from oil to natural gas to reduce fuel costs, improve efficiency with reduced heat rate, and reduce emissions. The City then requested conversion to start 2 years earlier than planned and on a fast-track basis. Study determined Unit 2 ST could accommodate installation of 2 F-class CTs and triple-pressure HRSGs, allowing conversion to be implemented in 2 phases to match load demand. S&L's cope for Phase 1 (1x1x1 CC) consisted of preliminary engineering, BOP procurement/ detailed design, construction support/commissioning support. Phase 2 conversion to a 2x1 arrangement delayed due to installation of 11 (11x9-MW) reciprocating engines to replace the retired Hopkins Unit 1.

- 2011 - "Top Gas Plant," *Power Magazine*
- 2009 - Pacesetter Plant Award," *Combined Cycle Journal*

COMBINED-CYCLE AND COGENERATION PROJECTS

Kaeng Khoi Block II

Client	Mitsui & Co., Ltd.
Location	Lopburi, Thailand
Plant Type	CC
Fuel	Gas and oil
Size	735 MW
COD	2008
CT Supplier	Alstom GT 26B
Configuration	2x2x1

Conceptual engineering, preparation of heat balances, cost estimates, layout system description, and review of EPC bids: GE 9FA, MHI 701F, and Alstom GT 26B considered.

Santan 5,6

Client	Salt River Project
Location	Gilbert, AZ
Plant Type	CC
Fuel	Gas
Size	600 MW (U5)/225 MW (U6)
COD	2005
CT Supplier	GE 7FA
Configuration	2x2x1 (U5)/1x1x1 (U6)

Complete integration of engineering, design, construction management, and startup support for two new gas combined-cycle units at an existing facility. Scope included conceptual design; detailed engineering; and design of all balance-of-plant systems; procurement support with the development of specifications and the technical evaluation of bids received; construction support (onsite and from the Chicago office); and startup support. Project earned the Industry's 2006 Gas-fired Project of the Year Award.

Bayside 1,2

Client	Tampa Electric
Location	Tampa, FL
Plant Type	CC repowering
Fuel	Natural gas
Size	1,750 MW
COD	2004
CT Supplier	GE 7FA
Configuration	3x3x1 (U1)/4x4x1 (U2)

The repowered plant, Bayside Units 1 and 2, involves repowering Gannon Units 5 and 6 with a total of 7 new GE 7FA combustion turbines and 7 HRSGs. In the repowering mode, Units 5 and 6 boilers were taken out of service.

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COMBINED-CYCLE AND COGENERATION PROJECTS

Columbia Energy Center

Client	Calpine Corporation
Location	Columbia, SC
Plant Type	CC cogeneration
Fuel	Gas
Size	500 MW
COD	2004
CT Supplier	GE 7FA
Configuration	2x2x1

Detailed design and technical field services, including selective catalytic reduction (SCR). The steam host is Eastman Chemical.

Bighorn

Client	Reliant Energy (NRG Energy)
Location	Las Vegas, NV
Plant Type	CC
Fuel	Natural gas
Size	550 MW
COD	2004
CT Supplier	SWPC 501FD/GE LM6000
Configuration	2x2x1

Complete EPC engineering, design, and procurement, including two Siemens Westinghouse 501FD combustion turbine generators; two triple-pressure HRSGs and a reheat condensing steam turbine.

Fairless Energy Works

Client	Dominion Energy
Location	Philadelphia, PA
Plant Type	CC
Fuel	Gas and oil
Size	1,100 MW
COD	2003
CT Supplier	GE 7FA
Configuration	(2)2x2x1

Detailed engineering and design of facility consisting of two 550-MW power islands located at a brownfield US Steel site.

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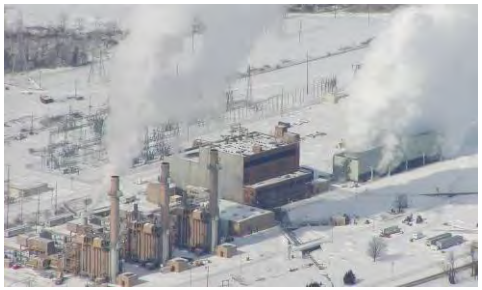

Noblesville

Client	Cinergy (Duke Energy)
Location	Noblesville, IN
Plant Type	CC
Fuel	Gas
Size	300 MW
COD	2003
CT Supplier	GE 6FA
Configuration	3x3x2

Feasibility study of repowering with various combinations of CTs and HRSGs, and detailed engineering and design for repowering based on GE CT and Foster Wheeler HRSG technologies.

Possum Point

Client	Dominion Energy
Location	Virginia/Washington D.C area
Plant Type	CC
Fuel	Gas and oil
Size	500 MW
COD	2003
CT Supplier	GE 7FA
Configuration	2x2x1

Complete design and engineering, including preparation of equipment specifications, procurement services, and significant input into the project integrated schedule.

Baglan Bay

Client	GE International
Location	Baglan, Wales, UK
Plant Type	CC cogeneration
Fuel	Gas
Size	520 MW
COD	2002
CT Supplier	GE 109H/LM2500
Configuration	1x1x1/1x1

Design and engineering for project recognized as the first commercial application of the Frame “H” combustion turbine technology in the world.

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COMBINED-CYCLE AND COGENERATION PROJECTS

Corpus Christi

Client	Calpine Corporation
Location	Corpus Christi, TX
Plant Type	CC
Fuel	Gas
Size	500 MW
COD	2002
CT Supplier	GE 7FA
Configuration	2x2x1

EPC contract awarded to JV between S&L and Zachry Construction Corporation. Project includes mechanical-draft cooling tower and is located on the CITGO Refinery property in Corpus Christi, Texas.

Equistar

Client	Reliant (NRG Energy)
Location	Channelview, TX
Plant Type	CC cogeneration
Fuel	Gas
Size	800 MW
COD	2002
CT Supplier	Siemens 501F
Configuration	4x4x1

EPC Joint Venture with Zachry Construction. Project management, engineering and design, procurement of engineered equipment, startup, and commissioning. Facility included four natural circulation duct-fired HRSGs, and one automatic extraction condensing steam turbine generator with a conventional condenser.

Magic Valley

Client	Calpine Corporation
Location	Edinburg, TX
Plant Type	CC
Fuel	Natural gas
Size	700 MW
COD	2001
CT Supplier	SWPC 501G
Configuration	2x2x1

Detailed design of the first application of this ‘G Frame’ technology in the United States. Included permitting support, site development, civil design, design criteria, substation design, P&IDs, piping installation drawings, power control cabling, steel and foundations, procurement support, interface with installation contractor, and startup support.

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Pine Bluff

Client	Calpine Corporation
Location	Pine Bluff, AR
Plant Type	CC cogeneration
Fuel	Gas and oil
Size	220 MW
COD	2001
CT Supplier	GE 7FA
Configuration	1x1x1

EPC joint venture with Zachry Construction. Full EPC services, including detailed design for construction of 1x1x1 using GE 7FA technology and 50-MW steam turbine. Independent power producer (IPP) plant provides electricity to a utility and electricity and process steam to adjacent paper mill.

John S. Rainey

Client	GE Power
Location	Iva, SC
Plant Type	CC
Fuel	Gas
Size	500 MW
COD	2001
CT Supplier	GE 7FA
Configuration	2x2x1

Initial project award for design of power island. Configuration based on GE 7FA dual-fuel CTs. Scope expanded to include two additional 7FA CTs. New units operating in simple-cycle but are convertible for future combined-cycle operation. Simple-cycle units bring total capacity to approximately 800 MW.

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SIMPLE-CYCLE PROJECTS

Charles D. Lamb Energy Center

Client	OMPA
Location	Kay County, OK
Plant Type	SC
Fuel	Natural gas
Size	103 MW
COD	2015
CT Supplier	Siemens SGT6 2000E

Scope included detailed BOP design (civil, structural foundations, mechanical piping, electrical auxiliary power system, instrumentation and controls), preparation of technical equipment procurement specifications, development of a GWC installation specification, bid evaluations and specification conformance. S&L scope also included site construction management support. The site was chosen due to its access to 345-kV electric transmission line and availability of a natural gas pipeline, as well as for its size, which will enable OMPA to expand to a 2x2x1 combined cycle configuration in the future.

Campbell 1

Client	Hawaiian Electric Co., Inc.
Location	Barbers Point, HI
Plant Type	SC
Fuel	No. 2 Fuel Oil and Biodiesel
Size	125 MW
COD	2009
CT Supplier	Siemens SGT6-3000E

Conceptual, design, permitting support, and detailed design for the simple-cycle addition. Air permits received in June, 2007, after which detailed design commenced. Providing construction management, startup, and testing coordination for power block and design for plant switchyard along with new transmission line to offsite substation.

Hopkins Peakers HC3 and HC4

Client	City of Tallahassee
Location	Tallahassee, FL
Plant Type	SC
Fuel	Natural gas and oil
Size	96 MW
COD	2005
CT Supplier	GE LM6000

Preliminary engineering, detailed design, and construction support for the installation of two GE LM6000 machines, including black start diesel generator. S&L's scope also included switchyard upgrade. This peak load generating facility consists of two GE LM6000 CTs that include SCRs and dry inlet chillers, a first in the U.S. Major systems (piping, conduits, etc.) were located underground in trenches.

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SIMPLE-CYCLE PROJECTS

Elgin 1-4

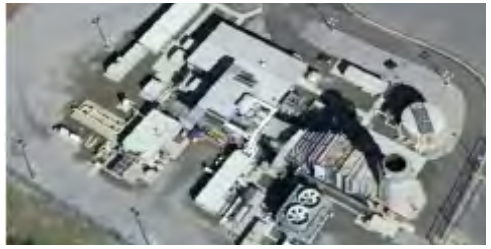
Client	Ameren Illinois
Location	Elgin, IL
Plant Type	SC
Fuel	Gas
Size	468 MW total
COD	2003
CT Supplier	SWPC 501D5A

Design, engineering, and permitting support for 4 x 117-MW gas-fired peaking plant, located on 33-acre industrial park.

3rd Avenue and 23rd Street (In-City Project)

Client	NYPA
Location	Brooklyn, New York, NY
Plant Type	SC
Fuel	Gas
Size	79 MW
COD	2002
CT Supplier	GE LM6000

Detailed design for two peaker units as part of larger project known as the In-City Project, an initiative to develop power within New York City.



Brentwood (In-City Project)

Client	NYPA
Location	Islip, Long Island, NY
Plant Type	SC
Fuel	Gas
Size	47 MW
COD	2002
CT Supplier	GE LM6000

Detailed design for one peaker unit as part of larger project known as the In-City Project, an initiative to develop power within New York City.

SIMPLE-CYCLE PROJECTS

Harlem River Yards (In-City Project)

Client	NYPA
Location	Bronx, New York, NY
Plant Type	SC
Fuel	Gas
Size	79 MW
COD	2002
CT Supplier	GE LM6000

Detailed design for two peaker units as part of larger project known as the In-City Project, an initiative to develop power within New York City.

Hell Gate (In-City Project)

Client	NYPA
Location	Bronx, New York, NY
Plant Type	SC
Fuel	Gas
Size	79 MW
COD	2002
CT Supplier	GE LM6000

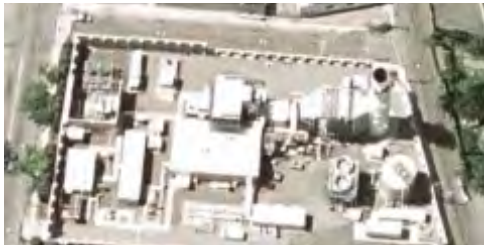
Detailed design for two peaker units as part of larger project known as the In-City Project, an initiative to develop power within New York City.

North 1st and Grand Street (In-City Project)

Client	NYPA
Location	Brooklyn, New York, NY
Plant Type	SC
Fuel	Gas
Size	47 MW
COD	2002
CT Supplier	GE LM6000

Detailed design for one peaker unit as part of larger project known as the In-City Project, an initiative to develop power within New York City.

SIMPLE-CYCLE PROJECTS



Pouch Terminal (In-City Project)

Client	NYPA
Location	Staten Island, New York, NY
Plant Type	SC
Fuel	Gas
Size	47 MW
COD	2002
CT Supplier	GE LM6000

Detailed design for one peaker unit as part of larger project known as the In-City Project, an initiative to develop power within New York City.

Vernon Boulevard (In-City Project)

Client	NYPA
Location	Queens, New York, NY
Plant Type	SC
Fuel	Gas
Size	79 MW
COD	2002
CT Supplier	GE LM6000

Detailed design for two peaker units as part of larger project known as the In-City Project, an initiative to develop power within New York City.

Southeast Chicago Energy Center

Client	Exelon Corporation
Location	Calumet, IL
Plant Type	SC
Fuel	Gas
Size	450 MW
COD	2002
CT Supplier	GE 6B (8)

Detailed engineering and construction management and power delivery services. Includes 8 GE 6B machines at a single site. Follow-on work associated with plant outage included addition of CEMS, DCS logic changes to the GE starting motors, and other smaller work packages. Reviewed client's operating alarm response procedures.

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SIMPLE-CYCLE PROJECTS

Aurora

Client	Reliant (NRG Energy)
Location	Aurora, IL
Plant Type	SC
Fuel	Gas
Size	890 MW
COD	2001
CT Supplier	GE LM6000 (6)/GE 7FA (4)

EPC JV with S&L, Graycor, and Sachs Electric (GSSL). S&L's specific scope included EPC project management, engineering and design, procurement of engineered equipment, startup, and commissioning activities.

Elk Mound 1,2

Client	Dairyland Power Coop.
Location	Elk Mound, WI
Plant Type	SC
Fuel	Gas and oil
Size	74 MW total
COD	2001
CT Supplier	GE 6B

Detailed design for installation.

Handsome Lake

Client	Constellation Energy (Exelon)
Location	Kennerdell, PA
Plant Type	SC
Fuel	Natural gas
Size	268 MW
COD	2001
CT Supplier	PW Aeroderivative FT8 TwinPac (5)

Detailed design for installation.

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SIMPLE-CYCLE PROJECTS

University Park

Client	Constellation Energy (Exelon)	Detailed design for installation.
Location	Chicago, IL	
Plant Type	SC	
Fuel	Natural gas	
Size	300 MW	
COD	2001	
CT Supplier	PW Aeroderivative FT8 TwinPac (6)	

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