

中國大陸 CAP1400 核反應器測試設施正在建設中



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由中國大陸國立核電技術公司(SNPTC)* 負責開發的 CAP1400 壓水式核反應器，其中一項被動式爐心冷卻系統的整合測試設施已經開始進行建設。

3 月 28 日舉行了一個測試設施 - 先進的爐心冷卻機制實驗工程 (Advanced Core-cooling Mechanism Experiment, ACME) - 的破土奠基儀式並進行首次的混凝土灌漿。它被建置在中國大陸的清華大學裡，清華大學參與了中國大陸本土化的 CAP1400 壓水式核反應器開發工作，CAP1400 乃是西屋電氣公司(Westinghouse)設計之 AP1000 的中國衍生版本。



被動式爐心冷卻系統測試設施正進行建造中 (Image: SNPTC)

ACME 設施將被用來模擬在“小破口(small break)”之喪失冷卻水事故(LOCA) 的情況下，CAP1400 被動式爐心冷卻系統的運作情況，以驗證該系統的工程設計，並收集熱流數據，俾供安全分析程式進行評估之用。ACME 的實驗方案由三部分組成：第一，小破口的喪失冷卻水 (small break LOCA) 事故之試驗，使用不同大小的破裂尺寸和破裂位置的情景；其次，對於非屬喪失冷卻水(non-LOCA) 事故之測試，如廠區全黑(station blackout)；第三，其他有關熱流方面之試驗。

ACME 設施主要的工程建設部分預計將於 2012 年的年中完成，而測試數據分析和電腦程式評估的部分則計劃將於 2013 年的年底完成。

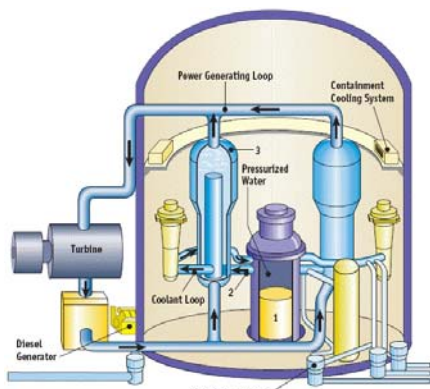
中國大陸國立核電技術公司(SNPTC)表示，ACME 設施建設計畫的啟動象徵著國家一個重大的里程碑，並且為及時提交支持 CAP1400 設計任務中所需之關鍵測試數據的驗證和評估資料，奠定了良好的基礎。

除了這個被動式爐心冷卻系統測試設施之外，還有其他幾個 CAP1400 的測試設施，包括一個為被動式圍阻體冷卻系統設計建造的整合測試設施，也正在建置中。

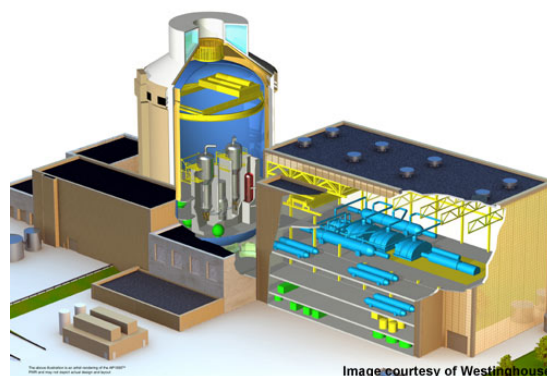
即將在山東省威海(Weihei)市附近廠址建造的第一座 CAP1400 的建設，預定在 2013 年 4 月正式開始啟動。SNPTC 公司將領導此建設計畫之執行，係基於 SNPTC 擁有此計畫承造公司之 55% 的股份。其他利益關係者有：華能核電開發公司(Huaneng Nuclear Power Development Corp.)，一家中國華能集團公司(China Huaneng Group)之附屬公司，China Huaneng Group 乃是中國大陸最大的電力公司之一。此計畫之合作夥伴希望他們所建造的第一座 CAP1400 能在 2017 年 12 月開始運轉。此型壓水式核反應器乃是根據先前由西屋電氣公司進口 AP1000 之設計而加以開發完成，其發電能量從 1100 Mwe 被提升到 1400 MWe。(請參考附件一)

註：

* **SNPTC** (中國大陸國立核電技術公司)創立於 2007 年 5 月 22 日，由中國國務院(State council of China)出資 60%，中國核工業集團公司(China National Nuclear Corporation)、中國電力投資集團公司(China Power Investment Corporation)、中國國家技術 I&C 公司(China National Technical I&C Corporation)及中國廣東核電集團公司(China Guangdong Nuclear Corporation)等 4 家企業各出資 10% 共同成立。該公司的產業發展重點為：1) 建造 AP1000 進步型壓水式核電廠；2) 研究發展發電能量大於 1350 Mwe 之中國大陸本土化的被動式進步型壓水式核電廠(類似美國西屋電氣公司“Westinghouse”設計之 AP1000)，譬如 CAP1400 亦或更大發電能量的 CAP1700。(請參考附件二)



CAP1400 雙迴路壓水式核反應器



Westinghouse 設計之 AP1000 進步型壓水式核電廠



中國大陸本土化的 CAP1400 核能電廠示意圖

資料來源：

1. **CAP1400 test facility under construction**, World Nuclear News, 4 April 2012. (英文版原文如後附)
2. **Chinese suppliers gain Gen-III qualification**, World Nuclear News, 14 January 2010. (附件一)
3. **SNPT R&D Center of China**, 簡報資料一份. (附件二)

[英文版原文]

CAP1400 test facility under construction



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Construction has started on an integrated test facility for the passive core cooling system for the CAP1400 reactor under development by China's State Nuclear Power Technology Corporation (SNPTC).

A groundbreaking ceremony and the pouring of first concrete for the test facility - known as the Advanced Core-cooling Mechanism Experiment (ACME) - took place on 28 March. It is being built at Tsinghua University, which is involved in the development of the CAP1400, a Chinese derivative of Westinghouse's AP1000 design.



Work gets underway on the passive core cooling system test facility (Image: SNPTC)

The ACME facility will be used to simulate the operation of the CAP1400's passive core cooling system in the event of a 'small break' loss of coolant accident (LOCA), to validate the engineering design of the system and to collect thermal-hydraulic data for safety code assessment. The experimental program of ACME consists of three parts: firstly, small break LOCA tests, with scenarios using different break sizes and break locations; secondly, for non-LOCA accident tests, such as station blackout; and thirdly, other thermal-hydraulic tests.

The main part of construction of the ACME facility is scheduled to be completed by mid-2012, while the test data analysis and code assessment are planned to be finished at the end of 2013.

SNPTC said the start of construction of the ACME project 'marks a major national milestone and has laid a good foundation for the timely submission of the validation and assessment of critical test data in support of the CAP1400 design.'

In addition to the passive core cooling system testing facility, several other CAP1400 test facilities, including an integrated test facility for the passive containment cooling system, are also being established.

Construction of the first CAP1400, at a site near Weihei in Shandong Province, is officially scheduled to begin in April 2013. SNPTC will take the lead with 55% of the project company. The other stakeholder will be Huaneng Nuclear Power Development Corp, a subsidiary China Huaneng Group, one of China's largest power companies. The partners hope their first CAP1400 will begin operation in December 2017. The pressurized water reactor is a development of a Westinghouse design currently being imported with its generating capacity boosted from 1100 MWe to 1400 MWe.

*Researched and written
by World Nuclear News*