



**UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207**

Memorandum

Date: 04/05/02

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SUBJECT : In-Depth Investigations Associated with Certain Vented Gas Appliances

The purpose of this memorandum is to report the results of a review of investigations associated with non-fire related carbon monoxide (CO) incidents and residential gas boilers, wall furnaces, and floor furnaces in the Consumer Product Safety Commission (CPSC) In-depth Investigation (INDP) File. This memorandum summarizes CO incidents associated with these appliances from the INDP file for the years 1987 to 2001 that were entered into the file prior to January 30, 2002. For the purposes of this review, CO incidents were comprised of those cases in which consumers were reportedly exposed to CO or a gas appliance reportedly leaked CO into the home or other structure. The review results will be used to support on-going staff work with the ANSI Z21/83 Committee, its subcommittees and Ad Hoc Working Groups to develop comprehensive performance requirements to reduce the risk of CO leakage and exposure from a variety of residential gas appliances.

CPSC staff from the Directorate for Epidemiology and the Directorate for Engineering Sciences reviewed the in-depth investigations in order to compile the information within this memorandum. This review focuses on reported conditions associated with appliance components, installation and operation, as well as deaths and medical treatment information associated with the incidents. Data from the CPSC In-depth Investigation File are not a statistical sample and national totals may not be derived from the number of incidents investigated. The data does provide examples of actual incidents and anecdotal information. See Appendix A for the codes and keywords used in the database searches.

The initial database search resulted in 160 in-depth investigations of incidents associated with carbon monoxide and gas boilers, wall furnaces, and floor furnaces. After the initial database search, staff screened the results to determine if the incidents were within scope. Incidents were considered out of scope for the following reasons:

- Incidents associated with fire.
- Incidents involving commercial type appliances used in a commercial building or large apartment buildings.
- Incidents involving appliances converted from solid fuel or oil to natural or liquefied petroleum (LP) gas.
- Incidents that lacked evidence of CO leakage or exposure.

In addition to screening out non-relevant incidents, staff also verified the occurrence of reported conditions associated with CO leakage into the home or other structure. This memorandum only includes CO leakage-related information that was corroborated by at least one authoritative, investigating source. Sources included the fire department, gas utility representative, service technician, forensic engineer, medical examiner's office, product manufacturer, housing authority, police, and local, state, or federal health officials. Staff included those cases that satisfied the following criteria:

- Investigative reports were collected by CPSC field investigators from the sources, or
- Investigative findings were recorded by CPSC field investigators through telephone or in-person interviews of the sources, or
- Investigative findings of the sources were reported to CPSC field investigators through interviews or investigative reports of third parties.

Finally, staff also verified the occurrence of CO exposures reported in the incidents. This memorandum only includes CO exposure information that was corroborated by at least one medical source and satisfied the following criteria:

- Medical reports were collected by CPSC field investigators from the medical source, or
- Medical findings or treatments were recorded by CPSC field investigators through telephone or in-person interviews of the medical sources, or
- Medical findings or treatments of the medical sources were reported to CPSC field investigators through interviews or investigative reports of third parties or consumers.

Throughout the remainder of this memorandum only those in-depth investigations that were considered in-scope and that were corroborated by either the authoritative investigative or medical sources noted above will be referenced. As seen in Table 1 this process resulted in a total of eighty-seven investigations that met these criteria. Eighty-two deaths were associated with these investigations.

**Table 1:
CPSC In-Depth Investigations Associated with Non-Fire Carbon Monoxide Incidents and
Certain Vented Gas Appliances, 1987-2001**

	Boiler	Floor Furnace	Wall Furnace	Total
Number of Investigations	56	14	17	87
Number of Deaths	41	14	27	82

Source: CPSC In-depth Investigation File, 1987-2001

Appliance Component, Operating and Installation Conditions Associated with Non-Fire Related Carbon Monoxide Incidents

Carbon monoxide leakage from a vented gas appliance into a home typically occurs as a result of two failures. The first failure is the occurrence of a condition(s) that results in an appliance producing elevated levels of CO. The second failure is the occurrence of a condition(s) that creates a leakage path from the combustion chamber or flue passageways into the living space of a home or other structure.

Incidents were classified according to the appliance and installation conditions reported to have been associated with the carbon monoxide exposure or leakage. These conditions were generally reported by the sources listed in Table 2. Table 2 will not add up to the number of investigations referenced in this memo because in 24 of the 87 investigations, information about the appliance and installation conditions was compiled from multiple sources. For example, one investigation reported both the fire department and a service technician as sources of information about the appliance's condition¹. Therefore this investigation would be counted twice in Table 2, once in the column citing the fire department as one of multiple sources and a second time citing the service technician as one of multiple sources. Therefore Table 2 will add to more than the number of incidents referenced within this memo. Incident information is typically collected by CPSC field investigators through the following mechanisms: (1) reports, memos or other official documents from the source(s), (2) interview of source (in-person or by telephone), or (3) on-site observation.

¹ 920107HCN0764

**Table 2:
Authority Reported as Sources of Information about the Appliance’s Condition**

Authority	Number of Incidents Where the Authority		Total
	Was the Single Source Reported	Was One of Multiple Sources	
Fire Department	12	12	24
Gas Utility/Propane Supplier	27	14	41
Service Technician/HVAC Contractor	12	15	27
Forensic Engineer	3	3	6
Building Inspector	5	5	10
Medical Examiner/Coroner	0	2	2
Product Manufacturer	1	2	3
Police	2	1	3
Local, state, or federal health officials	0	1	1
Housing Authority	1	0	1

Source: CPSC In-depth Investigation File, 1987-2001

Note: Since some incidents reported multiple authorities as sources of information, the total for this table will be greater than the actual number of incidents

The appliance conditions that were cited in the in-depth investigations and reported to be associated with CO leakage or exposure fall into three main categories: component conditions, installation conditions, and operating conditions. For the purposes of this review, component conditions were the physical conditions of those appliance components, attachments, systems, or parts reported by the source(s) to be associated with the reported CO incident. Component conditions were further stratified by the specific component, which included the vent, chimney, terminals (for both vents and chimneys), burners, and heat exchanger. In some instances multiple component conditions were reported.

Installation conditions focused on the building or structural conditions reported by the source(s) to be associated with the CO incident. Operating conditions generally focused on the appliance operating characteristics that resulted from component or installation conditions. For investigations where information on the appliance component, operating, or installation conditions were not reported within the in-depth investigation, the conditions were categorized as not reported. Table 3 summarizes the number of incidents involving single and multiple conditions reported in the in-depth investigations.

**Table 3:
Conditions Associated with Certain Vented Gas Appliances and Non-Fire Related
Carbon Monoxide Incidents**

Number of Incidents	Boiler	Floor Furnace	Wall Furnace	Total
Involving One Condition	24	10	7	41
Component Condition of the:				
Burners	2	0	0	2
Chimney	2	0	0	2
Flue & Draft Hood	0	1	1	2
Heat Exchanger (HEX)	2	1	1	4
Terminals (Vents & Chimneys)	0	0	0	0
Vent	12	7	4	23
Installation Condition	1	0	0	1
Operating Condition	2	0	0	2
Unknown Condition	3	1	1	5
Involving Two Conditions	16	3	6	25
Burner and Operating Condition	1	0	0	1
Burner and Vent Condition	2	0	1	3
Chimney and Operating Condition	1	0	0	1
Chimney and Terminal Condition	1	0	0	1
Chimney and Vent Condition	4	0	0	4
Flue & Draft Hood and Installation Condition	1	0	0	1
Flue & Draft Hood and Operating Condition	0	0	1	1
Flue & Draft Hood and Vent Condition	1	0	2	3
Heat Exchanger and Operating Condition	1	1	1	3
Heat Exchanger and Vent Condition	1	0	0	1
Terminal and Vent Condition	0	0	1	1
Vent and Installation Condition	1	2	0	3
Vent and Operating Condition	2	0	0	2
Involving Three Conditions	13	1	4	18
Burner, Chimney, and Vent Condition	1	0	0	1
Burners, Flue & Draft Hood, and Operating Condition	0	0	1	1
Burners, Installation and Operating Condition	1	0	0	1
Chimney, Flue & Draft Hood, and Operating Condition	2	0	0	2
Chimney, Heat Exchanger, and Installation Condition	0	1	0	1
Chimney, Vent, and Installation Condition	1	0	0	1
Chimney, Vent, and Operating Condition	2	0	0	2
Flue & Draft Hood, Vent, and Installation Condition	3	0	1	4
Flue & Draft Hood, Operating, and Installation Condition	1	0	1	2
Flue & Draft Hood, Vent, and Operating Condition	1	0	0	1
Flue & Draft, Terminal, and Operating Condition	0	0	1	1
Terminal, Operating, and Installation Condition	1	0	0	1

Involving Four Conditions	3	0	0	3
Burner, Heat Exchanger, Vent, and Operating Condition	1	0	0	1
Flue & Draft Hood, Vent, Installation and Operating Condition	1	0	0	1
Flue & Draft Hood, Heat Exchanger, Terminals, and Operating Condition	1	0	0	1

Source: CPSC In-depth Investigation File, 1987-2001

The general appliance component conditions associated with the reported CO incident was further categorized into more detailed descriptions of component, installation, and operating conditions. Tables 4 through 9 provide breakdowns of component conditions for vents, chimneys, terminals (for both vents and chimneys), burners, and heat exchangers. Table 10 provides a more detailed breakdown of installation conditions and Table 11 provides a more detailed description of operating conditions. Some investigations cited multiple detailed conditions associated with the more general component condition; therefore the number of detailed conditions associated with the component, installation or operating condition may not equal the number of investigations. For example, one investigation cited the vent as a component condition with two-detailed vent conditions (holes in vent and improper vent installation) associated with the incident². Table 12 provides a summary of the number of incidents associated with component, installation, and operating conditions. Since multiple conditions may have been associated with a single incident, totals will not add up to the total number of incidents referenced in this memorandum.

**Table 4:
Burner Conditions**

Burner Conditions	Boiler	Floor Furnace	Wall Furnace	Total
Total Number of Incidents Associated With	8	0	2	10
Number of Incidents Where Burners Were the Only Component Associated	2	0	0	2
Number of Incidents Where Burners Were Among Multiple Conditions Associated	6	0	2	8
Number of Detailed Conditions Associated With	10	0	2	12
Detailed Condition:				
Sooted Burner	4	0	2	6
Misaligned Burner	2	0	0	2
Detailed condition not recorded	4	0	0	4

Source: CPSC In-depth Investigation File, 1987-2001

Note: Number of detailed conditions may not add up to the number of incidents. Some incidents may have listed multiple detailed conditions.

² 010122HNE6083

**Table 5:
Chimney Conditions**

Chimney Conditions	Boiler	Floor Furnace	Wall Furnace	Total
Total Number of Incidents Associated With	14	1	0	15
Number of Incidents Where the Chimney Was the Only Component Associated	2	0	0	2
Number of Incidents Where the Chimney Was Among Multiple Conditions Associated	12	1	0	13
Number of Detailed Conditions Associated With	18	1	0	19
Detailed Condition:				
Blocked Chimney	13	1	0	14
Damaged Chimney Liner	2	0	0	2
No Chimney Liner	1	0	0	1
Detailed condition not recorded	2	0	0	2

Source: CPSC In-depth Investigation File, 1987-2001

Note: Number of detailed conditions may not add up to the number of incidents. Some incidents may have listed multiple detailed conditions.

**Table 6:
Flue & Draft Hood Conditions**

Flue & Draft Hood Conditions	Boiler	Floor Furnace	Wall Furnace	Total
Total Number of Incidents Associated With	11	1	8	20
Number of Incidents Where the Flue & Draft Hood Were the Only Component Associated	0	1	1	2
Number of Incidents Where the Flue & Draft Hood Were Among Multiple Conditions Associated	11	0	7	18
Number of Detailed Conditions Associated With	11	2	10	23
Detailed Condition:				
Blocked Flue	9	0	4	13
Disconnected Flue/ Draft Diverter	2	0	6	8
Holes in Flue	0	1	0	1
Rusted Flue	0	1	0	1

Source: CPSC In-depth Investigation File, 1987-2001

Note: Number of detailed conditions may not add up to the number of incidents. Some incidents may have listed multiple detailed conditions.

**Table 7:
Heat Exchanger Conditions**

Heat Exchanger Conditions	Boiler	Floor Furnace	Wall Furnace	Total
Total Number of Incidents Associated With	6	3	2	11
Number of Incidents Where the Heat Exchanger Was the Only Component Associated	2	1	1	4
Number of Incidents Where the Heat Exchanger Was Among Multiple Conditions Associated	4	2	1	7
Number of Detailed Conditions Associated With	7	3	2	12
Detailed Condition:				
Sooted Heat Exchanger	2	0	1	3
Clogged or Blocked Heat Exchanger	1	0	0	1
Cracked Heat Exchanger	2	3	1	6
Perforated or Holes in Heat Exchanger	1	0	0	1
Combustion Chamber Burn Through	1	0	0	1

Source: CPSC In-depth Investigation File, 1987-2001

Note: Number of detailed conditions may not add up to the number of incidents. Some incidents may have listed multiple detailed conditions.

**Table 8:
Terminal (Vent's & Chimney's) Conditions**

Terminals (Vent's & Chimney's) Conditions	Boiler	Floor Furnace	Wall Furnace	Total
Number of Incidents Associated With	3	0	2	5
Number of Incidents Where the Terminals Were the Only Components Associated	0	0	0	0
Number of Incidents Where the Terminals Were Among Multiple Conditions Associated	3	0	2	5
Number of Detailed Conditions Associated With	3	0	2	5
Detailed Condition:				
Damaged Terminal	1	0	0	1
No Terminal	1	0	2	3
Blocked Terminal	1	0	0	1

Source: CPSC In-depth Investigation File, 1987-2001

Note: Number of detailed conditions may not add up to the number of incidents. Some incidents may have listed multiple detailed conditions.

**Table 9:
Vent Conditions**

Vent Conditions	Boiler	Floor Furnace	Wall Furnace	Total
Number of Incidents Associated With	33	9	9	51
Number of Incidents Where the Vent Was the Only Component Associated	12	7	4	23
Number of Incidents Where the Vent Was Among Multiple Conditions Associated	21	2	5	28
Number of Detailed Conditions Associated With	44	12	10	66
Detailed Condition:				
Blocked Vent	11	3	6	20
Holes in Vent or Perforated Vent	5	1	0	6
Disconnected Vent	11	4	2	17
Vent Undersized	2	0	0	2
Improper Vent Installation	9	4	2	15
Vent Damper Failure	2	0	0	2
High Temperature Plastic Vent	3	0	0	3
Detailed condition not recorded	1	0	0	1

Source: CPSC In-depth Investigation File, 1987-2001

Note: Number of detailed conditions may not add up to the number of incidents. Some incidents may have listed multiple detailed conditions.

**Table 10:
Appliance's Installation Conditions**

Appliance's Installation Conditions	Boiler	Floor Furnace	Wall Furnace	Total
Number of Incidents Associated With	11	3	2	16
Number of Incidents Where the Appliance's Installation Was the Only Condition Associated	1	0	0	1
Number of Incidents Where the Appliance's Installation Was Among Multiple Conditions Associated	10	3	2	15
Number of Detailed Conditions Associated With	19	4	2	25
Detailed Condition:				
Inadequate Ventilation Air	8	2	0	10
Inadequate Combustion Air	11	2	1	14
Blocked Combustion Air Opening	0	0	1	1

Source: CPSC In-depth Investigation File, 1987-2001

Note: Number of detailed conditions may not add up to the number of incidents. Some incidents may have listed multiple detailed conditions.

**Table 11:
Appliance's Operating Conditions**

Appliance's Operating Conditions	Boiler	Floor Furnace	Wall Furnace	Total
Number of Incidents Associated With	18	1	5	24
Number of Incidents Where the Appliance's Operating Was the Only Condition Associated	2	0	0	2
Number of Incidents Where the Appliance's Operating Was Among Multiple Conditions Associated	16	1	5	22
Number of Detailed Conditions Associated With	20	1	9	30
Detailed Condition:				
Overfired	5	0	1	6
Lack of Maintenance	2	0	4	6
Improper Maintenance	7	0	1	8
Improper Replacement Parts	0	0	1	1
Filter Panel Not Sealed or On Completely	3	1	2	6
Other CO leakage Path Into Living Space	3	0	0	3

Source: CPSC In-depth Investigation File, 1987-2001

Note: Number of detailed conditions may not add up to the number of incidents. Some incidents may have listed multiple detailed conditions.

**Table 12:
Number of Incidents Associated with Component, Installation, and Operating
Conditions of Certain Vented Appliances**

Condition	Number of Incidents Where the Component		Total
	Was the Single Component Associated	Was One of Multiple Components Associated	
Component Condition of the:			
Burners	2	8	10
Chimney	2	13	15
Flue & Draft Hood	2	18	20
Heat Exchanger (HEX)	4	7	11
Terminals (Vents & Chimneys)	0	5	5
Vent	23	28	51
Installation Condition	1	15	16
Operating Condition	4	22	26

Source: CPSC In-depth Investigation File, 1987-2001

Note: Certain vented appliances include gas boilers, floor furnaces, and wall furnaces.

Note: Since some incidents reported multiple components associated with a single incident, the total for this table will be greater than the actual number of incidents.

Appliance Information

Information about the appliance's age and location in the building was also collected from the in-depth investigation. The location of the appliance was reported for 50 of the investigations. For those appliances where the location was known, 54% of the appliances were located in the basement and 30% were located on the first floor of the structure. Table 13 provides information on the appliance's location.

**Table 13:
Location of Appliance**

Location within Home	Boiler	Floor Furnace	Wall Furnace	Total
Basement	26	1	0	27
First Floor	5	3	7	15
Second Floor	1	0	0	1
Attic/Crawl Space	0	5	0	5
Garage	0	0	1	1
Other	0	0	1	1
Not Reported	24	5	8	37

Source: CPSC In-depth Investigation File, 1987-2001

The approximate age of the appliance was reported for 52 incidents. Based on the reported approximate age of the appliance and the date of the incident, the appliances in twenty-one of the incidents were manufactured during or after 1987. When the age was known, the age of the appliance ranged from less than 1 year to 50 plus years (Table 14). When the age of the appliance was given, 25% of the appliances were between 0 to 4 years, 21% were between 5 to 9 years, 13% were between 10 to 14 years, 4% were between 15 to 20 years, and 37% were greater than 20 years.

**Table 14:
Age of Appliance**

Age of Appliance	Boiler	Floor Furnace	Wall Furnace	Total
0 to 4 years	13	0	0	13
5 to 9 years	10	0	1	11
10 to 14 years	5	1	1	7
15 to 20 years	1	0	1	2
Greater than 20 years	9	4	6	19
Not Reported	18	9	8	35

Source: CPSC In-depth Investigation File, 1987-2001

The fuel type used with the appliance was reported for 89% of the 87 incidents. When the type of fuel was reported, 78% of the appliances were fueled with natural gas (80% for

boilers, 91% for floor furnaces, and 63% for wall furnaces) and 20% were fueled with liquefied petroleum (20% for boilers, 9% for floor furnaces, and 32% for wall furnaces). One-wall furnace was fueled with butane.

Carbon Monoxide Alarms Associated with the Investigations

Information on whether a carbon monoxide alarm was present at the location of the incident was also collected. The majority of the investigations (64) did not mention a carbon monoxide alarm, seventeen investigations stated that there was no CO alarm present, three investigations stated that there was an alarm present and the alarm was activated, and three investigations stated that there was an alarm present but the alarm did not activate. In each of the incidents in which the alarm was reported not to have activated, different reasons were cited. One of the incidents involved a color-changing detector and indicated that the color change was not discernible. In another incident the CO alarm reportedly activated prior to, but not during the CO incident. In the third incident, the CO level in the room the alarm was located in was reportedly below the alarm's activation threshold.

Ambient Carbon Monoxide Levels

Ambient carbon monoxide levels were provided for 46 (53%) of the in-depth investigations. In eight of the investigations, CO levels were cited from multiple investigative sources, such as fire departments or gas utilities. In the majority of the incidents where the CO level was known, the fire department or the gas utility representative was the authority who measured the CO level. In 37 (80%) of the incidents where an ambient CO level was given, the highest carbon monoxide level reported exceeded 100 ppm.

Medical Treatment Information

Eighty-two deaths were associated with the 87 in-depth investigations referenced within this memorandum. One hundred and seventy-one individuals reportedly sought medical attention for the associated carbon monoxide exposure and one hundred and sixty-eight (98%) of these individuals received some form of medical attention.

For those who received medical attention, the type of medical attention received was also examined. For thirty-three percent of the 168 individuals who obtained medical attention, the exact type of medical attention was not known as the investigation stated that the person was treated for carbon monoxide poisoning or exposure to carbon monoxide but did not provide the exact type of treatment. Three percent of the individuals receiving medical attention were given a blood test and then were released from the emergency room. Four percent of the individuals receiving medical attention were administered oxygen and then were released from the emergency room. Twelve percent of the individuals who obtained medical attention received a blood test and were administered oxygen before being released from the emergency room. Ten percent of the individuals who obtained medical attention underwent hyperbaric chamber treatment after initial treatment in the emergency room. Thirty-eight percent of the individuals receiving medical attention were treated initially in the emergency room and were later admitted to the hospital for further treatment.

Carboxyhemoglobin Levels

Carboxyhemoglobin levels were provided for 49 (56%) of the investigations. These 49 investigations involved 90 individuals. For thirty-seven of the forty nine investigations which provided CO levels, a copy of the supporting documentation was included within the documentation of the investigation. For the remaining investigations, CO levels were provided during interviews with third parties or consumers.

In the 49 investigations where carboxyhemoglobin levels were given, carboxyhemoglobin levels were completed by the coroner or medical examiner for 32 of the incidents (28 of which the coroner or medical examiner's reports were included within the investigation documentation). Twelve carboxyhemoglobin blood tests were completed by emergency room personnel (5 of which the lab report was included within the investigation). In two investigations, both emergency room personnel and the medical examiners office provided CO levels (one of which the coroner's report is included within the investigation documentation). For the remaining three investigations, CO levels were provided on police reports or gas company reports and these documents were provided within the investigation documentation.

For the 90 consumers where carboxyhemoglobin levels were reported, levels ranged from 2% to 85% saturation. Nine individuals had carboxyhemoglobin levels less than 10% saturation. Eighty-one consumers had carboxyhemoglobin levels greater than or equal to 10%.

APPENDIX A

The queries below were submitted through the EPIR application. Query results were manually reviewed to include carbon monoxide poisoning hazards and to exclude out-of-scope cases. In order to distinguish the floor and wall furnaces from the more general furnace categories, after the EPIR search was performed, the narratives were examined for 'wal' or 'floor'.

In-Depth Investigation (INDP) File

Date of Queries: 01/30/2002

Incident dates: 1/1/87 – 12/31/01

Product Codes: 308

Narrative contains: CO or CARB or MONO

Incident dates: 1/1/87 – 12/31/01

Product Codes: 310

Narrative contains: CO or CARB or MONO

Incident dates: 1/1/87 – 12/31/01

Product Codes: 322, 371-374, 384

Narrative contains: CO or CARB or MONO

Incident dates: 1/1/87 – 12/31/01

Product Codes: 389

Narrative contains: CO or CARB or MONO

Boiler In-Scope In-Depth Investigations Task Numbers:

000111HAA0264, 000111HAA0267, 000111HAA0268, 000224HEP9003, 000426HCC2484, 001120HWE6016, 001121HNE5904, 001212HEP9006, 010122HNE6083, 010306HCN0393, 010320HCC2328, 010521HCC2519, 880419WES5032, 881114CEN0272, 891122CCN0523, 891208HCN0624, 891211HCC1584, 891228HCC2112, 900123HCN0846, 900430HCN1459, 910208CCC3244, 911217HCN0637, 920107HCN0764, 920303HCC1580, 920325HCN1360, 920702HCC2196, 930209CCN0847, 930315HNE5092, 940128CEP9003, 940202CCN0717, 940208CCC2261, 940314CEP9002, 941028CWE5025, 941031CCN0375, 941205CCN0717, 950120CWE5024, 950206CCC1322, 950419CCN1710, 950426CCN1738, 951026CCN0151, 960108CCC2266, 960305CCN0691, 960715CCC5340, 970103HCC7194, 970417HCC2111, 971121HCC2129, 971215CCN0089, 980106CCC3496, 980122HCC2242, 980129HWE4205, 980210CCC2270, 980319CBB2429, 981015HCC2020, 990122HCC0243, 990204CCC2252, 990219HCN0131

Floor Furnace In-Scope In-Depth Investigations Task Numbers:

900125HCC3416, 900517HCC3546, 900913HCC2009, 910207HCC0131, 920506HCC0172, 920521CCC2391, 921002CCC2003, 930125HWE7014, 930210HWE4014, 940520CEP9002, 940706CWE7436, 941215CCC3159, 970513HCC2158, 970926HCC3354

Wall Furnace In-Scope In-Depth Investigations Task Numbers:

880120CCC0119, 880321WES5011, 890118WES4012, 900124HWE6002, 900517HCC3544,
920324HEP9002, 920714CCC2503, 930917CCC2614, 940218CWE5022, 940222HWE4003,
940316CCN1007, 940414CCC3424, 940414CWE7308, 940928CCC3991, 950316CCN1466,
951128HCC3033, 970416HCC2104